Proceedings from a series of regional seminars on microelectronics in the wood products industry.

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Forintek
Canada
Corp.

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Forintek Canada Corp.

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present

The Potential of Microelectronics

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Foreword

The following proceedings relate to a seminar entitled Where Are We Going? The Potential of Microelectronics presented in Kelowna, British Columbia on December 15, 1983. The seminar was the third of four regional seminars, on the same theme, which were presented at various locations in western Canada. The preceding seminars were held in Jasper, Alberta and Prince George, B.C. and one followed in Vancouver. Financial support for the seminar was from the federal Department of Regional Industrial Expansion.

Forintek Canada Corp. wishes to acknowledge the federal government contribution and the role of the Interior Lumber Manufacturers' Association as co-hosts of the seminar.

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Welcome

Peter Williams
Principal, Okanagan College, Kelowna, B.C.

My role is a very simple one this morning. I just want to welcome you all to Okanagan College. I am particularly pleased that we have the opportunity to host this conference because the forest industry is certainly a major factor in the economic life of this region. I think we all recognize the importance to the industry of taking advantage of the remarkable advances that are appearing in the field of microelectronics.

The business of this college, of course, is the design and delivery of programs of education and training and by that I don't mean only academic courses. We have, in fact, thousands of students in vocational programs including a number related to the forest industry.

I'd like to invite you, if you have any training or development or grading needs as a result of this conference, or for any reason, to get in touch with the college if you are located in this area. The area we serve goes from Revelstoke down to the U.S. border. We would be very happy to discuss with you your training needs and develop programs to try and meet those needs. If we don't have the expertise in-house, we can always bring people from outside this area.

* * *

Opening Remarks

Ray Clarke
Associate Director, Forintek Canada Corp., Vancouver, B.C.

This seminar today in Kelowna is number seven in a series of eight seminars that we've held across the country from Moncton, New Brunswick and we'll finish the series with a seminar in Vancouver on the 23rd of February.

The importance of the subject matter is, I think, demonstrated by the level of attendance that we've had from the industry at these seminars. At this point, we've had about six hundred people attending these seminars and that represents a lot of information and a lot of discussion and we're going to publish the proceedings of each of those seminars.

The subject matter that has been dealt with in all of these seminars has addressed the problems of computer assisted processing as it is affected by regional concerns. For example, the changing resource, problems of training, problems of selecting the right piece of equipment to do the right job in the particular operation. The seminars have all been jointly sponsored by the regional industry associations and at this seminar today your co-host is the Interior Lumber Manufacturers' Association. I would like to particularly thank Al McDonald for the work that's gone into bringing us all here today. The funding for these programs has been provided by the Department of Industry, Trade and Commerce and Regional Economic Expansion. That name has been shortened recently to the Department of Regional Industrial Expansion.

The funding is part of a program known as the Industrial Regional Development Program which is designed to assist industry in increasing productivity to meet the problems and opportunities of the '80's.

The role that microelectronics can play in increasing our competitive position is, I believe, better appreciated in our industry than in any other. I was a little surprised to learn that there are more computers assisting manufacturing operations in the wood products field than in any other sector and, of course, we have to be competitive because we export so much of our product, and that is particularly true in this part of the country.

Over the last decade, courageous managers have introduced computers and programmable controllers into their operations and equally courageous people on the shop floor have learned to use them, to maintain them and even to program them. Now a large amount of experience has been obtained and this places us in an excellent position to go the next mile. I am sure that the changes that lie ahead are much more dramatic than those that we have already fought our way through.

One of the pioneers in introducing computer assisted processing in this region and, in fact, in Western Canada, is Gerry Raboch of Riverside Forest Products. Gerry is also the president of the Interior Lumber Manufacturers' Association and will deliver the opening address.

* * *

Opening Address

Gerald Raboch
President, Interior Lumber Manufacturers' Association

On behalf of the lumber industry in the Southern Interior, I would like to welcome Forintek staff to Kelowna and Okanagan College for the purpose of sponsoring a special seminar on microelectronics.

I look at this seminar, and hopefully others in the future, to serve two purposes one for the educational value of the course and, secondly, as a vehicle to get the industry and Forintek to know one another better. Once that is accomplished, I believe that seminars such as this will be commonplace on many topics rather than on a spot occurrence.

The attendance here today, along with industry representation on panels, should indicate that there is a definite need and want for educational programs. Perhaps this showing of support can be some consolation for Tony French and the senior members of Forintek. I imagine that during the past year or so it got a little lonely out there at times.

It seems ironic that in Canada we are just getting around to learning more about the oldest building material in consistent use on the face of the earth. But to put in perspective, wood has been used to give us shelter and personal comfort for thousands of years, whereas the forests of Western Canada have been used extensively for only a matter of decades and Eastern forests for a slightly longer period.

Canada has been a dependable low cost supplier to the world, drawing on the advantages of a healthy and abundant first crop. That first crop is nearing an end; some parts of our country have no first crop left; some have, but marginal in quality and some of it is in areas that make it very expensive to harvest.

These harvesting problems, along with the added cost and responsibility of replacing the original crop, play a very important and critical part in our ability to keep on being an economical and dependable supplier to the world. The reality of making wood available at a reasonable cost is extremely critical since we do have to trade with other countries in the world who are not as prosperous as we are on this continent, especially Canada.

One of the responsibilities that we neglected when we made use of that original crop was to make provision for the continuation of that crop. The result is that we have hundreds of thousands of hectares that are not satisfactorily restocked, if at all, with a growth that has a real commercial value. There are steps currently being taken at the federal and provincial level to overcome this oversight, but it is not going to be rectified quickly or cheaply.

Supply at a reasonable cost is and always will be a critical factor in our trade with the rest of the world. If my overview has any validity as far as fact is concerned, it appears highly unlikely that the cost of our raw materials will go down.

How, then, do we maintain our position and overcome the competition from other wood suppliers in the world? Obviously, we are not going to do it on the basis of using high cost fibre with our present methods.

But we can do it by changes in technology. This change should allow us to covert it more efficiently, should allow us to increase our recovery, and should allow us to find the true value of our wood in terms of strength and engineering design.

I believe that seminars of this nature throughout the whole industry will create a most valuable atmosphere in which to develop methods and techniques. Seminars that are conducted and supervised under a broad umbrella in a consistent manner, rather than some haphazard, uncoordinated method that we have been depending on in the past.

I truly hope that the information you receive today will impress you enough that you ask for further instruction and start a pattern for ongoing seminars. Members of the panel and moderators, your time is sincerely appreciated by the industry. Thank you for your time. Forintek staff and management, may this be a start of a long and successful program for the betterment of our industry and the nation in general. This type of approach, I believe, will again make us prime, dependable and profitable suppliers of wood for our own use and, more importantly, for the rest of the world.

* * *

Forintek — Its Role in the Program

Craig Walden
Director of Research, Forintek Canada Corp., Vancouver, B.C.

The principal theme of my talk is "what is the problem" with a lesser emphasis on the role of Forintek. In in any business organization we take a very careful look at industry problems, which in our case are also our own problems.

Table 1 is a summary of the present and projected markets for your products. You will notice that there are two dates with real values for 1980 and estimated values for 1990. Total lumber shipments are estimated to go up from four to 4.6 billion dollars, with a minor increase in the domestic consumption and a rather major increase in export shipments. The world demand for fiber products is expected to go up about three per cent per year over the next decade, actually continuing on close into the year 2000. Of that three per cent, approximately one per cent is estimated to be in the area of solid wood products, and slightly less than one per cent will be in the area of softwood lumber. There is going to be a modest drop in the amount of wood products to be used for building purposes. This is mainly related to the drop in the housing starts that is projected for countries like the U.S., the U.K., Japan and so forth. There is expected to be a corresponding increase in the amount of use in the industrial markets, such as pallets, crates, frames, even industrial construction. Here, of course, we are going to have to compete with steel and concrete. There is also a very considerable market shaping up in the home renovation field.

So, all in all, we may not be the darling of the stock market, but we are going to have growth. We are going to be in a growing industry; so basically speaking, this is not our major problem. Maybe growth will not be as fast as we would like it to be, but certainly we are going to be in a growth industry.

What are some of the other facets that make up our costs and our ability to compete? Certainly, labor productivity is one and in Figure 1 are four curves showing productivity in the Canadian forest industries during the last 16 years. The upper dotted line is the veneer plywood mills; the lower dotted line is the sawmills and planing mills; the light solid line is pulp and paper; and the overall average is the heavy dark line. I would like to call your attention particularly to the fact that there is a very sharp rise in productivity in the sawmilling industry between the years 1975 to 1979 and it has levelled off since that time. As a matter of fact, Figure 2 shows that it has dropped slightly.

Two of the curves from Figure 1 have been transposed onto Figure 2. In other words, the two dotted lines in Figure 2 are the same as the two dotted lines in Figure 1, i.e. for the veneer and plywood mills and for the saw and planing mills. Also plotted here are the unit labor costs in the sawing and planing mill area and in veneer and plywood. You will notice that, particularly since 1979, the unit costs have gone up in the sawmilling industry, whereas they have stayed relatively stable in the veneer and plywood industry.

But what's our overall productivity? In other words, how much solid wood product do we produce per man-hour compared to some of our competing nations, particularly the NorScan countries and in our largest market, the United States? Canada has got a clear jump, quite obviously a clear jump (Figure 3). It has traditionally been this way. Certainly, this figure indicates that it has been this way for the last 16 years. We are considerably ahead of the both the NorScan countries and ahead of the United States. But when we come to apply the unit labor costs, what do we get?

In Figure 4 we get a slightly different story. Now you have noted the rather sharp increase in labor costs that has happened in the last three or four years in the sawmilling industry, as shown in Figure 3. In Figure 4 you see that our productivity while we have again this tremendous jump between 1975 and certainly up to 1977 we do have a declining overall productivity in terms of dollars since 1977. At the same time the

NorScan countries have caught up to us and, in some instances, have passed us. So we do have the problem with making our labor more productive. This is part of our ongoing problem.

Now, what about materials? Figure 5 shows the demand for softwood timber in Canada over the last 40 years and estimates of demand until the year 2000. The dotted line shows the economically accessible timber reserves. Of course, we cannot produce more lumber than there is timber, but if we are to hold our share of the market, these are the demand projections. You can see that over the next 17 years, the supply of readily accessible timber is not going to be sufficient to meet our market needs. So we are going to have to utilize other materials. We are going to have to go to more expensive timber. It is going to be more difficult to harvest and it will be less readily accessible. Sometimes it will be of dubious quality and sometimes we will be working with second growth, highly managed, intensively cultivated stands. The net result is that in Canada it is projected that between now and the end of the century the cost of our raw materials will go up at a rate of three per cent per annum.

Now, what is going to happen in our competing countries? In the NorScan countries, they have already made this jump. They are working on second growth. They already have the intensively managed stands. It is not much consolation that they have been paying these costs all along. Their costs are not going to go up. They are projected to remain relatively constant. In the United States the increase again is going to be much less than ours because their plantations are already in place and they are looking at something like modestly less than a one per cent increase per year in the cost of their raw material.

It is not a great deal of consolation that we have had the advantage in raw material costs because we have needed it. But the fact remains that our competitors, our competing countries in the export market, have already learned to utilize this raw material effectively. This is one of our challenges for the future.

Now, you can say, "What about quality?" I think one of the things that the Canadian sawmilling industry has always felt is they have had a sort of a 'corner on the market' with regards to quality. It is true that we have had an abundance of high quality fiber in the past. The situation is changing as we switch to these new resources. When you look at the overall picture it is really best summed up in the quotation that comes from the Forest Industry Advisory Committee report, chaired by Messrs. Barclay and Buchanan and submitted to the Honourable Ed Lumley last summer, which says that, "There is no shortage of cellulose fiber in the world." Furthermore, the report goes on to state that, "The world has an infinite capacity to make do if the price is right." In other words, we are going to have to be intensively competitive. As the years go by, we are going to have to learn how to get more out of our logs and we are going to have to learn how to improve our productivity.

Table 2 will give you some idea of where we stand as far as getting more out of our logs. This may be considered to be one aspect of the utilization of capital although we cannot totally separate this from the labor component. These values are the volumes of logs that are needed, expressed in cubic metres, to produce a cubic metre of solid wood products. The smaller the volume of logs needed to make one cubic metre of product, the better off you are. If you go down the column for sawn softwood, you will see we are second highest. Now, if you note that little asterisk on the number for the United States the asterisk says that those figures are based on actual dimensions rather than nominal dimensions as are the other four figures. When you put the American value on a comparable basis the 2.61 drops down to somewhere between 1.8 and 1.9, so we don't look very good. This is an actual situation. We haven't paid as much for our raw material, so obviously we have been less careful in utilizing it. This has to change.

There are a lot of things we are going to have to do. We are going to have to enhance our labor productivity. There is a lot of technology out there for doing that. This is one of the major thrusts of this seminar to bring to you some information on the technology that is out there to improve your productivity, to improve your utilization. I am sure you are all familiar with scanners and optimizers and automation in the sawmill. Much has been done and Forintek has a major role in ensuring that, whatever the source, you have access to this new technology.

Forintek has another major role and this is the provision of new technology; technology that is specific to this area; technology that no one has yet thought of; technology which is developed as a result of a close examination of the specific problems of a specific region. Nonetheless, it is a reflection of the cost of raw materials in some of our competing countries, that we are now borrowing their technology to enhance the kind of conversion that they have developed to meet their own specific challenges.

At Forintek, our role is technology. As Canada's national wood products research institute and working for a national institute, you would expect us to identify and develop new technology. In our research and development efforts, we are trying to develop new technology that you can utilize in your industry. Those efforts, which are directed to assisting the sawmilling and the plywood sectors, literally

dwarf everything else we do at the Western Laboratory. About half of our effort is spent identifying and developing new technology for the sawmilling and plywood industries. About 30 per cent is spent developing codes and standards. This may seem rather strange to you. Previously this has been primarily a government function. The fact remains that if your lumber is not accepted in the building codes and standards of the markets to which you ship be they Canadian, American, in the United Kingdom, Western European, or Japanese you literally do not have a market. The current push on ingrade testing, with which I know most of you are familiar, is a typical example of how crucial acceptance of codes and standards in the various markets is and of the necessity to develop the technical information, not only to market your lumber, but to provide continuing market support.

A third aspect of our role is to develop training and education programs. The current seminar is a typical one. We spend about 20 per cent of our effort doing this. Some of you, I know, will be familiar with other seminars that we have put on. A lumber drying seminar was given at our laboratory in the spring of 1983. We have recently given a similar two-day seminar at Prince George. We are putting on a relatively large number of regional seminars on various topics. In the coming year, we have approximately 50 seminars planned which will be given at some nine to 12 locations across Western Canada. They are intended primarily to be a follow-up on the kind of a seminar we have here and will relate to impovements in productivity. However, we will be dealing with specific topics such as saw filing, saw optimizers, etc.; specific topics which will be geared more to regional problems and we will bring regional competences to bear.

A few of the technological developments we have been responsible for in the last two to three years are now coming into use by the B.C. industry. I am not going to outline a great deal more about them, other than to indicate that we really do produce technological advances that are pertinent to your own specific problems. You can use them right here in British Columbia. We have teams that come out into the mill and tell you how to do this. A typical example is our lumber size program and certainly the mills that have accepted it have indicated that they can get a three per cent improvement in yield with literally no cost at all.

But are we doing enough? I am not really going to try to answer this question. All I am going to do is refer to Figure 6. This figure shows the number of dollars, as a percentage of the value of annual production, that have been spent in various countries over the last five years over the five year period from 1975 to 1978 on research and development. You will notice that the U.S. is first. They spend about 0.8 per cent of the dollar. Canada is at the bottom and, quite frankly, we don't think it is enough.

In conclusion, I would like to say that we do need your support. We do want your support and we hope you do feel that you need us.

* * *

Table 1

Actual and Estimated Shipments of the Canadian Wood Products Industry (billions of 1980 $)

	Domestic		Export		Total	
	1980	1990*	1980	1990*	1980	1990*
Lumber	0.6	0.7	3.4	3.9	4.0	14.6
Exterior Panels	0.4	0.5	0.2	0.3	0.6	0.8
Mill Work	1.0	1.5	0.1	0.3	1.1	1.8
Other Wood Products	2.2	2.2	0.5	0.7	2.7	3.5
Totals	4.2	5.5	4.2	5.2	8.4	10.7

Table 2

Conversion Factors Relating Input of Raw Material to Output
(m3 solid wood volume in the rough/m3 production)

COUNTRY	END PRODUCT				
	Sawn Softwoods	Sawn Hardwoods	Particle-Particleboard	Plywood	Fibreboard
Finland	1.93	1.68	1.24	2.94	1.41
Norway	1.97	-	1.48	-	1.61
Sweden	2.00	1.84	1.48	2.54	1.74
Canada	2.05	2.26	0.96	2.71	0.79
U.S.	2.61*	2.09	1.45	2.22	0.80

*Production based on actual dimensions, all others are based on nominal dimensions.
Source: F.A.O. Conversion Factors for Forest Products.

Figure 1.

LABOUR PRODUCTIVITY IN THE CANADIAN FOREST INDUSTRIES
1965 - 1981

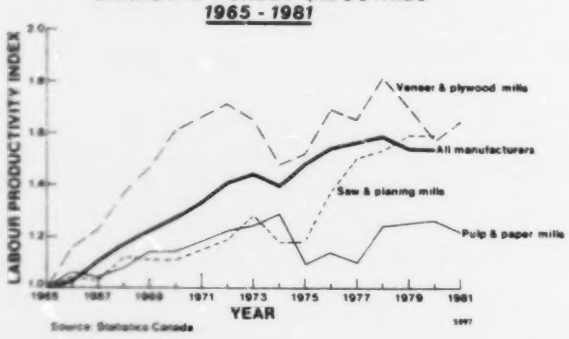


Figure 2.

INDICES OF PRODUCTIVITY AND UNIT LABOUR COSTS - CANADA (costs in 1965 funds)

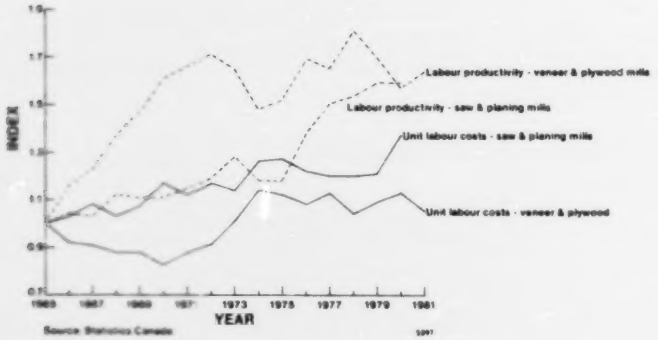
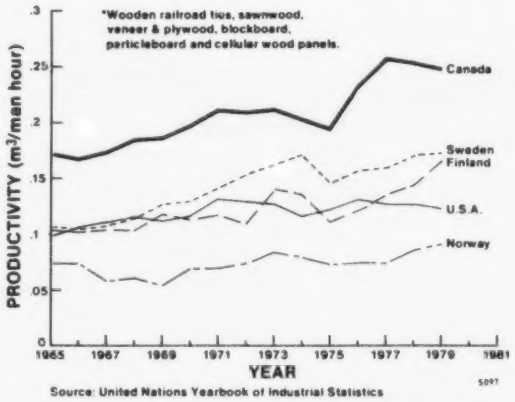


Figure 3.

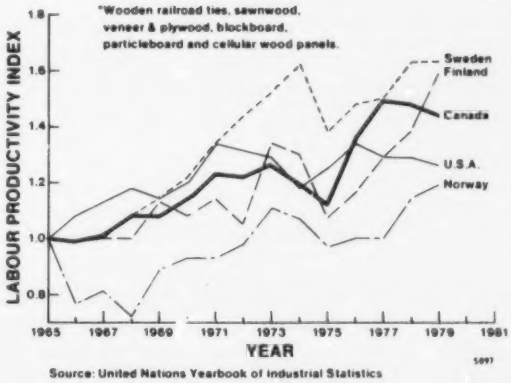
LABOUR PRODUCTIVITY IN SOLID WOOD PRODUCTS* (m³ per man hour)



Source: United Nations Yearbook of Industrial Statistics

Figure 4.

LABOUR PRODUCTIVITY INDICES IN SOLID WOOD PRODUCTS*



Source: United Nations Yearbook of Industrial Statistics

Figure 5.

CANADA'S SOFTWOOD TIMBER HARVEST: DEMAND PROJECTIONS

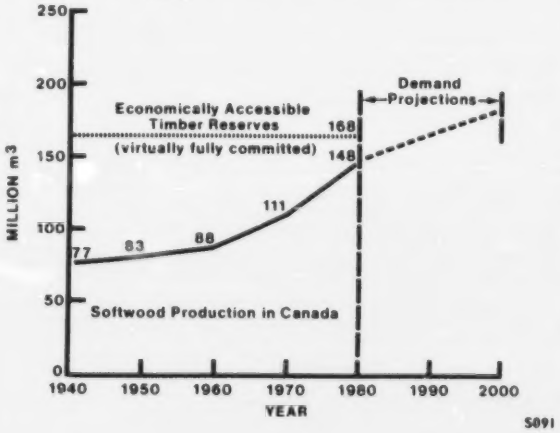
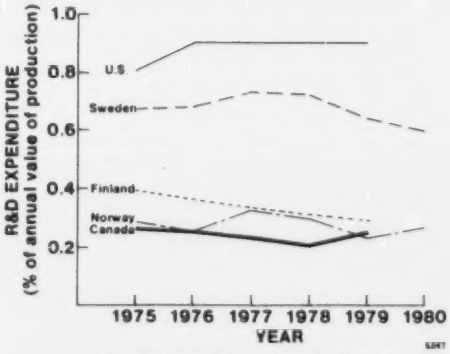


Figure 6.

RESEARCH AND DEVELOPMENT EXPENDITURES BY GOVERNMENT AND INDUSTRY IN WOOD BASED INDUSTRIES



Sources: U.S. National Sciences Foundation
U.N. Yearbook of Industrial Statistics
Dept. of Industry, Trade & Commerce, Canada

Microelectronics: Where Are We Going?

Bob Blanchard
1st Vice President
Western Canadian Regional Council No. 1, IWA
Vancouver, B.C.

I am presenting this outline as a result of a request from Ray Clarke, the associate director of Forintek, to the International Woodworkers of America to have labor's views expressed at this gathering.

For the past five and one-half months, we have been playing our traditional role the adversaries. We have been performing this role at the bargaining table. However, these kind of gatherings are beginning to indicate that though we have an adversarial role to play, we can also work together to resolve common concerns.

I want to preface my remarks by stating that most of my experience in the forst industry has been in coastal operations. There has been very little opportunity to see the effects of technological change down there. I understand you are a little more into it in the interior versus the coast.

Let me state quite clearly that the opinions I express here today are not necessarily views and opinions shared by the entire labor movement. In actual fact, I would venture to say that the IWA's philosophy towards the introduction of technological change differs considerably with other labor bodies, be they public or private sector unions.

The IWA has traditionally supported the need for modernization. The truth is, we have publicly admonished the forest industry in B.C. for their lacklustre performance in updating their operations; in actual fact, you could say we have made a career of it.

The unforunate tardiness (and I use the word loosely) has cleared a legitimate and growing concern for us, however. A slow and steady or partial introduction of technological change would have allowed the transition to take place with little or no direct job loss as a result of a computerized conversion. The decrease, if any, in jobs and membership would have been absorbed through natural attrition.

The ramifications of a complete and total changeover of an entire mill or mills causes untold consternation for the union, the employer, the government, the economy, but first and foremost for the employees facing displacement, retraining or, even worse, unemployment.

Historically, employment growth in our industry has been slow relative to other sectors of the economy. For example, over the past four decades the significance of manufacturing employment has diminished substantially; in 1940 it accounted for approximately 40 per cent of all non-agricultural employment but by 1980 that figure had declined to only 22 per cent. The era of microelectronics will accelerate that trend.

Technogical change is not creating jobs in our industry; it is creating employment in the high-tech field. The only specific exception to that statement is in the trade categories. The ratio of trades people vs. production workers has teetered dramatically in favor of the maintenance personnel. The traditional skills of the trades has had to be drastically revised to accommodate the introduction of computers.

The IWA, as I stated earlier, supported the introduction of modern production methods, not for any sanctimonious reasons; we were chiefly interested in the elimination of the onerous, tedious and back-breaking jobs found in our industry. Unfortunately, the child, in our eyes, has become a monster. Technology is beginning to hurt the worker *per se*.

The high-tech syndrome now reaches out and attacks the skilled and semi-skilled as well as the

laborer. The high wage earners, i.e. sawyers, are becoming 'attendants' rather than 'operators'.

We are on the horns of a dilemma. We recognize and support the need for change in order to survive in the competitive world market, but what good is survival if the right to retain an income is taken away from you as a result of modernization.

The primary industry which we the IWA represents had a membership high of approximately 58,000 in 1978-1979. We will be fortunate to maintain a level of 40,000 membership the coming years.

Now, I don't expect everyone to shed too many tears over the plight of the poor IWA. But I do expect some insight into what will happen to the increased products being produced when the potential consumer base is shrinking even faster than productivity is spiralling.

Employers and governments yes, even you and I have an obligation to maintain the delicate balance needed between producer and customer. Ideas that seemed unheard of 20 years ago, ideas that seem radical or unrealistic today, must be explored, must be considered, must even be introduced or enacted.

The present day employer must undertake an extensive program of retraining. He must also give more than 'passing thought' to guaranteed annual salaries, productivity sharing, or a 'workable' form of job sharing.

Governments must be cognizant to the possibilities of early retirement, bridging of pensions and drastic reductions to the work week as it presently exists. More specifically to the forest industry, governments must release the millions of dollars needed for reforestation and silviculture. Failure to do so could hasten the demise of our industry at an even greater speed than it is today.

You and I must set aside some of our traditional hang-ups and bug-a-boos and re-tool our thinking; we must learn to co-exist with the advent of the microelectronics generation. Those things that seemed absurd and preposterous a decade ago may be our only chance of survival tomorrow.

The forest industry's profile, especially on the coast, is going downhill. We must turn that around. They are losing their effectiveness on the economy and that is self-defeating.

The large, integrated companies must change their attitudes; they must become more aggressive in the area of export. Being solely dependent on one market is wrong in this age of computers. Industry must capture the alternative markets in Japan, China and the U.K. We have to improve our markets to be able to use our new-found technology so that we can utilize those high cost, high quality trees. That, under today's production methods, makes them economically useless.

I could have gone into a long statistical dissertation on the effects technological change has had or is having within our industry. I could have given examples of the new versus the old. But what for? It will suffice for me to say that the leadership of the IWA understands the necessity for change, but we equally understand the need for a parallel program and change in attitudes designed for resolving the plight of the displaced or unemployed workers.

In closing, I would like to mention that I had the opportunity to tour Europe with a joint group of labor/management people to study industrial democracy's role there. Our union preached about more industrial democracy in the workplace, while a lot of management people were coming back from Europe saying, "Boy, they have got Utopia over in Germany and Sweden, you people should see what it's like over there." So we went to Europe, six of us from each side, and we all came back with the same final thought. Some of the things they do over there as far as industrial democracy goes may work well in Europe, some of it may work in Canada, but our systems are so different that to try and attempt to bring any program from one country to another and make it work is totally impossible.

If we are going to develop a program in the field of industrial democracy or technological change, then we have to do it within out own country and not with the exclusion of specific groups. Every group has to be involved and that includes labor. We play an important role. The attitudes of all of us must change drastically or the era of the 'chip' may herald in the final curtain.

* * *

Training Programs to Meet Industry Needs

Charles McCaffray
Principal, College of New Caledonia,
Prince George, B.C.

First of all the title is Training Programs to Meet Industry Needs. And I am delighted with the second half of that title, the "to meet industry needs" phrase. Having been 32 years in the education business, if there is one thing that has distressed me over the years, it is the thousand training programs we have run in this country at government expense, and sometimes at the expense of companies, that don't meet anybody's needs, industry's or the employee's or anybody else. All they really do is keep people off of the streets for a while, who are fundamentally unemployed. I guess it solves the problem of getting them off the streets. In turn, I have to hire teachers and it saves the teachers being umemployed.

I'm a Scot and I hate to see my money being wasted that way, so "industry needs" is what training is all about, and I am delighted with it.

The special needs that we in this institution see in terms of training for the industry in the late 80's are as follows. You are, all of you, involving yourselves with new technology at different levels. We know there are companies also exploring and actually implementing product diversification. New technologies and new products means new skills. I hope, in many cases, new skills for the existing work force, rather than simply displacing the existing work force and bringing in bright young people to replace them. And I have nothing against bright young people; I just think that people that happen to pay taxes for twenty or thirty years deserve a break too that's the existing work force. There is a special need.

You are all looking at technology because it is part of survival, improved productivity. Improved productivity also means new kinds of skills to look at the old problems in a different way; it means training of a different type.

I am told that, increasingly, the supervisors in the sawmilling industry, as was pointed out by Bob Blanchard of the IWA, the supervisors have to know the whole operation as a total entity and not just part of it. And they have to know it at on an operating level, not just a theoretical level. And that operation, if it becomes more technological, becomes more complex. That means just having the worker doing it; knowing about it is not good enough. The supervisor above him has to know about it too because he has to make key decisions.

And then finally I am told that the industry has an aging work force. I get sensitive when people talk about aging work forces, because I am now part of it. But I am told that in some of our major companies in B.C. right now as many as 70 per cent of the major decision-makers will have left the industry within the next five years. That needn't be a problem as long as the people are being trained to take over from them. And that is a very specific aspect of industrial training that I think we need to give more attention to.

If we look at training, I would just like to share a few facts and figures that many probably know better than I. Nearby is Lakeland Mills and by improved productivity, by buying improved new equipment and by introduction of new processes they have increased their recovery. They have reduced from three shifts to two, and still improved output. The manpower, however, has remained the same, from 56 to 60 workers. However, what is interesting is the shift from unskilled to skilled. The unskilled work force has dropped from 18 to 10. However, the number of electricians is up by four, the number of filing operators up by four, the number of millwrights up by three. In other words, within that existing mill a clear shift from unskilled to skilled has been part of the process of improved productivity. Surely, that is where we are going.

The second thing I would say about that, however, is that that training was done mostly on the job. And I would submit to you as a person who is on the institutional side of the business, that for far too long we have assumed that institutions can do too much of the training. Much more of it has to be done on the job in partnership with the industry, and directed specifically at a better return on the investment on one hand, and better working conditions for the employee in the plant on the other. That is what it is about, and you can't do that sitting in a college classroom. It doesn't mean to say we have no role. We have a role, but we can't pretend to solve everybody's problems all of the time, or at least every time we try to do it all we fall flat.

Recently the Federal Government under the Critical Skills Training Program, together with the Skills Growth Fund established a year ago, has targeted the national resource sector as an area of priority. They have identified anticipated national shortages in forestry technicians, forest product technologists, electrians and electronic technologists four fields that I think all of you have a direct need for. They are now national priorities in the eyes of the federal government at least. At the provincial level, millwright, planermen, lumber grader, wood pattern, microcomputer and supervisory skills have been identified as areas where we will have difficulties in the next five to 10 years unless we do something about training. Now the federal program, having identified the priorities as national projects, has now put into place a procedure whereby if a person already has the technological training, an employer can pick-up $6.25 an hour for a two year period for ongoing training of a member of the work force. That represents a fairly sizable investment from the federal side in the upgrading of your existing work force. It is a fairly recent announcement, and it is one that you may want to think about very seriously. And clearly if an institution like this can be of assistance, we are interested, but that is not the most important thing.

In identifying those priorities in terms of training, let me share with you a little personal concern, and then I'll say something about what we are doing here. The personal concern I have is this. It is entirely understandable that in a day and age where we have a million unemployed, in a day and and age where more people are assuming we will always have a million unemployed, there is an understandable reaction that says, "well, with all those unemployed we shouldn't put money in training". It is understandable, but it is suicidal. It is absolutely suicidal. We have to advance the thesis in this college, that the time of significant downturn in economy is the time when you should be investing more time, more money, and more energy in raising the skills of your work force. Because the one thing that is certain is that five years from now when things are turning around, we are going to need in all of our industries higher and higher levels of skills. If you don't train these skills in today's Canadians, then you will buy them from foreigners tomorrow. And when you go that route, it is not a million unemployed you are looking at, it is very many more. So the investment in training is an investment in your future.

At CNC we, at present, have two year businesss programs, two year electronic programs and forestry and electrical apprenticeships. They all relate to your activities. We have a transfer program in lumber and plywood ready to go.

More important, though, the immediate training needs of industry, in my judgement, do not revolve around two and three and four year programs. That is totally unrealistic. The universities chose that route years ago and we have allowed the university pattern to dominate the college pattern. What we need more of and what this institution and others are moving to are programs like the Forintek seminars. Two week courses, one week courses, weekend workshops, six week sessions, courses where the individual can be working half time for a limited period of time so that he combines the earning capacity on one hand with the learning capacity on the other. This makes more sense from everybody's point of view. We this summer, in partnership with BCIT, ran a pulp summer institute for one full week; 60 people attended. It was sold out; it was actually more than we had originally planned for. We are running at the present time, again in partnership again with BCIT, a six week industrial electronics program. We will be starting in January a soils and ecology program with RPF Credit, provided by UBC, but through CNC. Forintek ran a lumber drying course the last two days here and the attendance yesterday was in excess of 30 people. Vibration analysis, a one week program, is in preparation in CNC for next summer. We are running management skills programs for supervisors that consist of four three-day sessions spread out over a two year period. It is 12 days, but it is over two years, so it can be fitted into work schedules. And you would then be slotted in with other suitable industrial people.

We have looked recently at a two week planer mill program that was being run successfully by West Fraser. I heard great things about it. I gather it has folded. We are suggesting that maybe we sit down with West Fraser and see if there is any way that that successful program can be reactivated, the college simply providing assistance. Last summer we had a one day seminar with a speaker from West Germany on the Linck sawmill process. I don't think it has a very great application to the B.C. industry, but I am not an expert. The important thing is a lot of people got to see and understand and make their own decisions.

We are talking then about a training for industry that says, "it must be flexible in time." That means there is nothing wrong with a one day or a one week or a one month course. It doesn't have to have the dignity of a whole year. Flexible in terms of the arrangements, it can be combined with work and in some cases it should happen in the work place. Why are we not doing some of that training in the sawmills. There is no good reason why it all has to happen at CNC, or in any other college.

Secondly, there should be evidence of partnership. Among the things I just listed for you there were three or four cases it was CNC and BCIT, in some cases it is CNC and UBC, and in other cases it is CNC simply providing whatever assistance it could to Forintek. We are not really in the business, I hope, of any more empire building in education. CNC is not important, the service we provide is. If we can provide a service by somebody with more expertise doing so, then we are meeting our mission. Joint industry/college partnership is one of the keys.

Next, job specific training. If the job training is not specific to a job, then serious questions should be asked about investing corporate or public dollars in it. Now that is a bit of heresy. There are those who say we should spend a lot more time in teaching people fine art and philosophy and theatre and dance. We do all of those things in this college and they are important. But when you boil it down to the question of either giving the people the skills to move the economy and support their families or those other skills, there is any question where a simple Scot like I stands. It is called 'the basics of the economic survival come first'. Even if that isn't very popular, and doesn't get headlines, job specific training is essential.

And then, finally, we do need an critical look at the whole business of managerial training. Mangers who understand technology, who understand different kinds of engineering as well as management techniques. I was interested to hear the observation by the previous speaker about not transferring the industrial democracy concepts of West Germany here, and I couldn't agree more. They won't transfer. I would go further in saying the great fad we have at the moment about transferring Japanese managerial skills to Canada has just as much chance of success. It might be a device whereby consulting companies are running conferences at $600 a crack and making a big profit, but it has no bearing on the reality of Canadian industry. It just isn't going to work. We must design our own managerial skills for our own world of today. Not Japan's world of yesterday, nor Germany's world of tomorrow.

Finally, CNC is in process of establishing another institute which will be separate from the College and which, within the next two months, will be dedicated to advanced technology for the forest and mining industries. We already have about $3 million dollars worth of CAD/CAM equipment in boxes. We will have in excess of $100,000 for robotics. And we will be adding specialized training in automation, hard automation systems for sawmills, robotics, numerical control, laser technology and fibre optics. The thing about that institute, when it opens, is that it will have an industrial board, it will not run under the Ministry of Education. Its target is that within five years it will run by supporting itself, by doing training for industry, by doing applications engineering and by providing that kind of assistance directly with industry. I know that we can design institutions which can, in partnership with industry and acting as industrial enterprises, support itself without day-to-day dependence on government grants. Perhaps a measure of that approach in our colleges today would cause us to reconsider our present programs. The Institute will work for industry, with industry and like industry.

* * *

The Industrial Regional Development Program

E.W. Smith
Senior Industrial Development Officer
Government of Canada, Department of Regional Industrial Expansion

I have been asked to discuss the new industrial development program administered by my department. As mentioned earlier, we are now called the Department of Regional Industrial Expansion.

The new program we have is called the Industrial Regional Development Program (IRDP) and is intended to replace a whole host of programs previously administered by the Department of Regional Economic Expansion (DREE) and the Department of Industry, Trade and Commerce (IT&C).

First, I would like to mention that the program is regional, with most of the decisions being made in Vancouver rather than in Ottawa as was previously the case. Secondly, for the first time, federal industrial assistance is available to all regions of the province. All census districts in B.C. have been mathematically assigned a development index. In the case of B.C., we have Tier I and II areas. The three measureable factors which have been used to calculate this index are the level of unemployment, the level of income per person in the census district and the fiscal capacity of the province. These are weighted on the basis of unemployment at 50 per cent, the level of income per person at 40 per cent and the fiscal capacity of the province at 10 per cent.

IRDP provides differing levels of assistance in each tier. Tier I areas are considered the least disadvantaged and comprise 50 per cent of the population of Canada. Tier II covers the next 30 per cent. There are also Tier III and Tier IV areas in Canada that cover the remaining 20 per cent. They are the most disadvantaged economically, but fortunately there are none in B.C. It's all Tier I and Tier II.

Let me run through the six major program elements. The first is called Industrial Development Climate. Assistance may be made available in the form of grants to enable economic, business or technological institutes to undertake special activities having significant and direct benefits to regional industrial development. Examples of this is our support of this exercise today. You may also have read that we put some $15 million towards the construction of a lab for the Pulp and Paper Research Institute on the UBC campus in Vancouver for construction this spring.

The second program element is called Innovation. Assistance may be provided for projects to develop or demonstrate new or improved products or processes. These must be scientifically feasible, entail significant technical risk and represent attractive prospects for commercial exploitation.

There is an element for Plant Establishment which applies in Tiers II, III and IV only.

Under Modernization Expansion, assistance may be made available for the acquisition of new advanced machinery and equipment which significantly enhances the productivity of existing activities in manufacturing, processing, selected services related to industry and tourism operations. Some people will expand and modernize at the same time. This is eligible as well.

Of course, adaptation of microelectronics technology is applicable. Funding may be provided to manufacturers and processors for the first installation of microelectronic devices in their products and operations, for design of custom microelectronic devices and for incorporation or application of electronic dependent products or systems in products, processes, production methods or facilities.

I mentioned that in most of the other program elements, our level of assistance can be up to 25 per

cent of the eligible capital costs in Tier I and 35 per cent in Tier II. In the case of the application of microelectronics, in Tier I the maximum sharing ratio is 50 per cent and in Tier II it's 60, indicating the importance the federal government places on the application of microelectronics to industry.

The next one is marketing. We can supply marketing assistance to people to open up new markets, to promote existing markets and to help sell, particularly overseas.

There is a final program element called Restructuring which is really used when people find themselves, for a variety of reasons, producing the wrong product.

Often people say, "What does your department do?" "What are you trying to accomplish?" What our department does is to attempt, where we can, to increase the economic prosperity in all regions of the country. We try to stimulate the establishment, expansion, productivity, competitiveness, and innovative capability of business enterprises in order to realize maximum economic potential. This takes a variety of forms, as indicated by the way our program is structured into a number of elements. The program is a good one. It is something that I feel adds great potential to assist industry to be more innovative, to grow, modernize, be more profitable, and employ more people in the province.

What are the eligibility criteria? They are really fairly simple. We would like to support only those businesses which have a very good chance of viability. We are not looking for cripples to prop up. In fact, we have no effective way of bailing out businesses in trouble.

Secondly, the project must demonstrate that there is a need for government funds in order for the project to go ahead. In other words, to make things happen that otherwise wouldn't.

The third is that the project must be of significant benefit to Canada. There are a number of measures of significant benefit, but they should be significant economic and social benefits to the country.

So there is the assistance under our program. The assistance is under the form of grants. We don't use the word 'grants' anymore. It is called 'Nonrepayable Contributions'. I don't know what the difference is, but that is the new buzz word.

In closing, I would like to underline a couple of thoughts. First, it has been said and it is true the forest industry of Canada must attain and retain international competitiveness. We must be constantly developing new products and new processes and better ways of doing things because we have lots of competition out there. Canada is not the largest producer of forest products but we are the largest exporters. We are the largest exporters of lumber, we are the largest exporters of newsprint and we are the largest exporters of market pulp. So you can be sure that everybody in the world has their eye on you people and what you are doing. You will be aware of *Madison's Lumber Reporter*. I haven't seen their subscription list, but I sure have seen the publication in a lot of strange places, in Scandinavia and Europe. They also read *Random Lengths* and the *B.C. Lumberman* just to know what we're doing because we are a big player in the game. But at the same time, it is a big world out there and we are not sitting on a pile of green gold. Just because we have the wood doesn't mean we are going to be able to sell it. Also, we must deliver it to Tokyo, London, Antwerp, Dallas, New York, wherever. We must deliver it at an economic price and this means we have got to be internationally competitive and all that that implies.

There was also some previous discussion about productivity. One of the ways to improve productivity in a sawmill is to run it flat out and you can't have good productivity if you are shut down half the time. The ones that run flat out are the ones that can compete, the ones that are efficient.

The other question is the whole business of raw material supply and I think that this is very important. Better utilization was cited as a way to better use our raw material. But another interesting factor here is the very, very close relationship between our raw material base and productivity. We all know that if the price of lumber is $250 per thousand, you can afford to pay a little more for logs, and you can go after them in more awkward places. However, if the price drops, and I'm talking about delivered price now, which includes the cost of processing, then you practically have got to have them on a flat piece of ground right next door to the mill in order to break even. So, there is a relationship between productivity and your raw material base. If you can keep your costs competitive in logging, manufacturing and transportation, then your raw material base is going to be larger.

The other thing that I think we have to meet is what I like to call 'the challenge of managing change'. We all know that if we apply microelectronics to the manufacturing process, people are sometimes displaced. I think we must try to identify those people early on in the planning process. Why don't we try to identify them while they are still Henry, Joe and Pete, rather than wait until they are identified as the 'unemployed' of the area. It has been explained here that there are training programs for people and other ways of dealing with the problems. I believe there is

an opportunity for cooperation between management, labor, government, researchers and the academic community in developing better ways of managing change.

* * *

Profit Opportunities Through High Technology

Jim Swanson
Manager, Lumber Manufacturing Technology,
Forintek Canada Corp., Vancouver, B.C.

I would like to review some of the experiences we have had at Forintek, based on our files and studies, that will indicate existing profit opportunities in sawmilling operations. The worldwide focus today is on improving productivity and recovery in sawmilling operations.

Forintek has been involved in these activities for a number of years through a project known as the Sawmill Improvement Program. It began in the Eastern laboratory when Forintek was part of the Canadian Forest Service, Eastern Forest Products Laboratory. With the formation of Forintek, these activities have expanded rapidly. In the past four years, we have had the opportunity to study in excess of 70 individual sawmill log breakdown systems in over 50 different sawmills. As a result of these studies, we have gathered a large amount of information and data. We generally find several areas in the manufacturing process that lend themselves readily to improvement. We have made the objective of the program to identify these areas in existing operations and estimate their potential economic impact.

There are at least six areas that can nearly always yield substantial benefits (Figure 1). These include the following: improving the log quality entering the mill, paying careful attention to the log allocation within the mills, optimizing log breakdown procedures, minimizing lumber sizes, improving productivity itself and establishing efficient drying practices.

All of these can have a substantial impact on the overall profitability of any sawmilling operation. For a few minutes, I would like to discuss examples we have generated with actual mill data. I'll start with improving log quality entering the mill.

In the area of log quality entering the mill, there are five or six areas that we are particularly concerned with. The log quality entering the mill is extremely important for several reasons, one of the primary ones is that mistakes, particularly in log bucking, cannot be corrected anywhere else in the manufacturing process.

Normally, we are concerned with sweep, crook, log length, over length and debarking, to name a few (Figure 2). There have been extensive studies, and much information published on the effects of sweep and crook. I don't plan to cover these areas extensively. The other three points including log length, over length and debarking, are areas that should not be overlooked because there is often room for substantial improvements in economic benefits in these particular areas. Let me explain what I mean by log lengths.

Generally speaking, we like to produce log segments that will produce lumber in the sizes we are going market. In other words, we want to produce a correct nominal log length and give it a minimum trim allowance only. We collected data in a number of sawmills. Here are examples of some things we often see. This mill was marketing even length lumber in eight, 10, 12, 14 and 16 foot lengths which is fairly common. Generally, we market in two foot increments. The Number One log was 12 foot 9-1/2 inch actual log length. This log should have been trimmed to 12 foot 5 inches. It actually had a four and a half inch overtrim. Another log in the same batch was measured at 11 feet 10 inches. This situation is extremely detrimental because to get back to the next nearest lumber size, almost 17 inches of trim has to be removed. This represents a substantial loss in fibre. In a 16 foot log, that represents a 12-1/2 per cent loss of lumber. Although it is an extreme example, it is not uncommon.

In another sawmill producing even lengths, we found the average trim was running 6.9 inches in excess allowing for even and odd lengths. The particular mill, however, was only marketing lumber in the even lengths, so the actual overtrim was 8.6

inches. If we assume a five inch trim would be sufficient for this entire group of logs, the overtrim would average 3.6 inches.

If this could have been recovered as lumber, what would the benefit be? (See Figure 3.) We found that assuming most of the overtrim could be turned into lumber by careful bucking, we could increase our lumber recovery from 6.4 to about 6.51, for a lumber recovery improvement of 1.7 per cent. Now, 1.7 per cent is not a great deal, but what would it mean to a lumber operation producing 100 million board feet of lumber per year? It would add an additional 1.7 million board feet of lumber to that operation. We have calculated the potential benefit by assuming a selling price of $200 a thousand and subtracting a drying allowance of $12 per thousand and a planing and dressing allowance of $26 to come up with an additional lumber value of $275,400 (Figure 4). We would lose chip revenue, so we adjusted for lost chip revenue and still show a benefit amounting to almost $210,000 from a 3.6 average overtrim.

I will now discuss the area of debarking. Substantial savings can be made in debarking. We have a tendency to use too much pressure or too little pressure in debarking and as a result we end up with chips in our bark or bark in our woodchips. Bark in the woodchips is bad. These errors result in lost premiums from the woodchip buyers, or lost lumber recovery.

We used the Best Opening Face Program to simulate the effects of using excess pressure in the debarker and removing, inadvertently, a tenth of an inch from the log (Figure 5). A tenth of an inch all the way around would result in two tenths of an inch reduction in diameter. This calculation is based on a 6.4 inch diameter log, 12 feet long. We assumed it to have two inches of taper, and used the split taper and log cant portions of the Best Opening Face Program. You can see that normally this log would be expected to yield 27 board feet of lumber. If we removed one tenth of an inch of fibre because of debarking errors, this would be reduced to 24 board feet of lumber resulting in a reduction of lumber recovery factor from 7.22 to 6.42, or 11.1 per cent. What could this mean to a lumber operation producing 100 million board feet of lumber? (See Figure 6.) If we assume that instead of 11 per cent we only get two per cent, and ignore any revenue out of chips, we would add an additional two million board feet of lumber per year. Adjusting the value for drying and planing, we come out with a net benefit of $324,000 from a 1/10 inch loss of the outer shell of that tree.

Now let's discuss log allocations. Generally we are talking about yield and recovery as a function of production lines, and/or productivity as a function of production lines, and also profitability by diameters. The first two areas generally refer to running two production lines simultaneously. We studied a two production line mill. The small log line was designed to handle logs under seven inches, and the large line logs over seven inches. We found 10 per cent of the large logs were actually less than seven inches, so they were below the minimum, and 20 per cent of the small logs exceeded the seven inch diameter maximum. We analyzed that data for optimum allocation. The results are shown in Figure 7. We see that had the logs been processed on the proper line through optimum log allocation, we could have increased our lumber recovery from 5.77 to 6.01. This represents an overall improvement of four per cent in lumber recovery. What would this mean to a sawmill producing 100 million board feet. The four per cent increase would add an additional four million board feet annually to this sawmill (Figure 8). This additional lumber would have a value, adjusted for planing and drying, of $648,000. However, we would lose chip revenue. When adjusted for the loss in chip revenue, we obtained a potential net benefit to this operation of $492,000 based on proper log allocation.

The third area involves optimization of log breakdown and log breakdown systems. We all know the cost of delivering wood into the sawmill is rising rapidly so there is a strong emphasis and need to improve lumber recovery. We must remember a couple of points regarding applications of new technology. The log breakdown process itself is one of many processes in the mill. The overall recovery is only going to be as good as those processes that both precede and follow the log breakdown system itself. We can have the best computer controlled breakdown system, but if we are doing a lousy job either before or after, we are not going to get the full benefits.

There are some substantial things one can say for computerized log breakdown. Firstly, computerized log breakdown minimizes operator errors. Secondly, it allows you to target breakdown patterns for marketing purposes, either to maximize value or to produce products that are more marketable. This can have significant impact in terms of marketing. Computerized optimizing systems are dependent on two things: efficiency of the scanning system and efficiency of the diameter sort to sawing diagrams at the headrigs. The 11 per cent difference in recovery that we considered at the debarking station due to taking away a little excess fibre around the log can also occur at the headrig if your scanning is not accurate.

Now let's look at minimizing lumber size. There are three things that we generally have to do to maintain minimum lumber sizes. Firstly, we have to establish a minimum lumber size for our particular sawmill. Secondly, we have to track it on an ongoing and careful basis and stick to it to reap the benefits. What

are the components of a lumber target size? They include the final dry, dressed lumber marketing size, the green dressed marketing size, a planing allowance if we are planing, a shrinkage allowance if we are drying, and a sawing variation. Any lumber or wood in excess of these can be considered oversizing and unnecessary. We generally lose the excess in the form of lower value planer shavings. We would like to recover it as higher value chips and lumber. The following is an example of reducing a target size by 1/16th of an inch. The simulation indicated that the top two by four was increased from 12 to 14 feet by reducing the target size a sixteenth of an inch. This translates into a lumber recovery of about 2.6 per cent. Many mills today are again actively interested in lumber size control programs. We are finding that yield improvements from two to four per cent are commonly achievable and feasible. How much of this can be recovered is up to the mill, but generally it can be achieved at a minimal cost. What would this mean to a lumber operation producing 100 million board feet of lumber? (See Figure 9.) If we ignore the value of additional chips, focus on increased production and assume a two per cent increase in lumber recovery factor, the additional volume would amount to two million board feet annually, and would have a net value of $324,000.

Next I would like to discuss productivity itself. Productivity is extremely important and is significantly impacted by two items: downtime and delayed time. Downtime is the period when the machine is down due to electrical and mechanical problems. I like to focus on delay time. Delay time is that time when the machine is actually available for processing, but because of problems in mill flow, it is not processing material. Delay time is harder to detect and often frustrating to the operators. Because delays are usually of short duration, they are easy to overlook. We have measured delays in sawmills that range from less than one per cent to over 17 per cent. These delays are caused by such things as lack of material, logs being jammed up at the unscrambler, log handling problems, or surges, downstream delays or chipper jam-ups.

What do these delays in productivity cost? (See Figure 10.) We made the assumption that one could achieve a five per cent reduction in delay time. Since this five per cent reduction is associated with time that can be totally productive, it will result in an increase of five per cent in productivity. There are two ways to economically analyze the benefits of this. One is to look at the cost savings from a more efficient operation as presented next. Assuming fixed and variable costs of seven million dollars a year, we have recalculated the operating costs for this mill after reducing delay time by five per cent. This saved the operation 25 shifts annually. When pro-rated back to a year, we calculated $14,000 in variable costs per shift. Higher efficiency saves the variable costs, and this case would amount to about $350,000 per year. One would like to use the saved time for production, provided logs are available (Figure 11). This would increase production five per cent or by five million board feet, with additional revenue of about $1,125,000. Subtracting the cost of logs, processing, drying, and planing, which amounts to $640,000, we still realize a net benefit of almost $500,000 per year from a five per cent reduction in delay time.

Next, I would like to address lumber drying which can have significant impact on profitability. Generally, we dry to meet the 19 per cent moisture content standards. A general rule of thumb derived by several large companies states that a one per cent reduction in the moisture content, below the fiber saturation range, results in a one per cent loss in lumber value. This is generally the result of increased degrade. We can also derive benefits out of raising the average moisture content from reductions in heat and other kiln costs.

In the following we have analyzed the cost of drying from an average moisture content of 15 per cent down to 12 per cent, a three degree drop in moisture content (Figure 12). The three degree drop corresponds to three per cent decrease in lumber value, and since we are considering a 100 million board feet per year operation at a $200 per thousand price, this is equivalent to a $6 per thousand loss due to degrade. The costs of drying and heating amount to 35 cents per thousand board feet. Additional costs amount to 15 cents, for a total overdrying cost of $6.50 per thousand. This represents an annual cost in excess of $650,000 due to overdrying by three per cent. Shipping dryer lumber results in freight savings of about $1.10 per thousand. These have to be subtracted from the cost. The net cost of overdrying is still in the neighbourhood of $540,000. These potential benefits are the driving force for the development of new kiln control systems.

In conclusion then, the combined areas that I have discussed in relation to a 100 million board foot per year operation suggest substantial savings can be made (Figure 13). In this case, if we simultaneously achieved them all it would amount to 2.2 million dollars annually.

I would like to leave you with one final thought. Expenditures or costs incurred as a result of improving yields or increasing productivity, can generally be readily paid back.

* * *

Figure 1

Manufacturing processes that often can be readily improved

- Improve Log Quality Entering Mill
- Improve Log Allocation
- Optimize Log Breakdown
- Minimize Lumber Size
- Improve Productivity
- Reduce Drying Degrade 1

Figure 2

Factors to consider in determining log quality entering mill

- Sweep
- Crook
- Log Length
- Overlength
- Debarking 1

Figure 3

Recovery improvements from reducing overtrimming by 3.6 inches

	Log Volume (cf)	Lumber Tally (bf)	Lumber Recovery Factor	LRF Improvement (%)
Study Logs With Overlength	2847.2	18,222	6.40	
Study Logs Without Overlength	2798.8	18,222	6.51	1.7

Figure 4

Economic benefit from reducing overtrimming by 3.6 inches

Annual Production	100 MMbf
LRF Increase	1.7%
Additional Lumber Volume	1,700 Mbf
Additional Lumber Value	$275,400
Reduced Chip Value	$ 66,300
1,700 x 78 x 24	
2400 x $50/BDU 1	
Net Benefit	$209,100

Figure 5

Analysis showing potential recovery loss in debarking

Log Diameter (in.)	BOF* Yield (bf)	LRF	Difference (%)
6.4	27	7.22	
6.2	24	6.42	11.1

- 6.4 inch log
- 12 ft. long
- 2 in. taper
- split taper log and cant sawing

*based on a target size of 1.875 in. 1

Figure 6

Economic impact of removing 1 inch of wood during debarking

Annual Production	100 MMbf
LRF Increase	2%
Additional Lumber Volume	2,000 Mbf
Additional Lumber Value 2,000 (200 - [12 26])	$324,000
Reduced Chip Value	—
Net Benefit	$324,000

Figure 7

Potential lumber recovery improvement from correct log allocation

		Small Log Line LRF	Large Log Line LRF	Mill LRF	Improvement (%)
Study Log Allocation	5.51	5.98	5.77		
Optimum Log Allocation	5.64	6.31	6.01		4

Figure 8

Economic impact of proper log allocation

Annual Production	100 MMbf
LRF Increase	4%
Additional Lumber Volume	4.0 MMbf
Additional Lumber Value 4,000 (200 - /12 26/)	$648,000
Reduced Chip Value $\frac{4,000 \times 78 \times 24}{2400}$ x $50/BDU	$156,000
Net Benefit	$492,000

Figure 9

Economic impact of reducing target size by 1/16 inches

Annual Production	100 MMbf
LRF Increase	2%
Additional Lumber Volume	2 MMbf
Additional Lumber Value 2,000 (200 - [12 26])	$324,000
Net Benefit	$324,000

Figure 10

Economic impact of 5 per cent productivity improvement from reduced costs

Annual Production	100 MMbf
Operation Cost (sawmill fixed & variable, excl. logs)	$7 MM
Operating Cost/Mbf	$70 Mbf
Delays	5% or 25 shifts
Normal Shift Production	200 Mbf/shift
Variable Cost/Shift	$14,000/shift
Variable Cost Savings (25 shifts x $14,000)	$350,000
Net Benefit	$350,000

Figure 11

Economic impact of 5 per cent productivity improvement including added production potential.

Annual Production	100 MMbf
Delays	5%
Additional Lumber Volume	5 MMbf
Additional Revenues · Lumber $200/Mbf · Chips $50/BDU	$1,000,000 125,000
	$1,125,000
Minus Added Processing Costs for Logs Drying and Planning (5 MMbf x $128/Mbf)	$640,000
Net Benefit	$485,000

Figure 12

Analysis of cost of overdrying from 15 percent to 12 percent moisture content

Annual Production	100 MMbf
Cost of Overdrying From 15% to 12% M.C.	
· Degrade (1% Value Loss per 1% Decrease in M.C. (1% x $200/Mbf x 3% M.C.)	$6.00/Mbf
· Heat - add 104,000 BTU/Mbf (104,000 BTU x $3.33/MMBTU)	$0.35/Mbf
· Other Costs	$0.15/Mbf
Unit Cost of Overdrying	$6.50/Mbf
Annual Cost of Overdrying	$650,000
Freight Savings Due to Shipping Weight Reduction ($1.10/Mbf x 100 MMbf) Shipping Rate $4.45/cwt	$110,000
Net Cost of Overdrying	$540,000
or	
Potential Net Benefit	$540,000

Figure 13

Summary of potential economic benefits from six areas for a mill producing 100 MMbf annually

Elimination of Overlength	$209,100
Improved Debarking	$324,000
Improved Allocation	$492,000
Minimum Lumber Size	$324,000
Reduced Delays	$350,000
Eliminate Overdrying	$540,000
Total Net Benefits	$2,239,100

Log Merchandising

Al Coombes, Manager
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Since most of our speakers are in the supply sector and the technical sector, I want to discuss log merchandising from a management perspective and at the same time thread in the microelectronics and the microprocessor side of things. I want to do this through two aspects. One is a case study on what we did at Williams Lake, where, in 1977, I was involved in construction of a plywood plant, a sawmill modernization, and the organization of a wood supply system. I want to lead readers through a case study on some of the things we did that might be of interest and stimulate some thought. Secondly, I want to discuss some things that are happening in the area at the moment and some thoughts we have developed as to where we are going next in the microprocessing area.

I want to mention an experience I had about a month and a half ago when I went to Japan to look at plywood technology there. The first thing that struck us was their wood cost, which was somewhere in the magnitude of 120 dollars a cubic meter. At one particular plant we visited, they took us out to the log lift area where the wood was coming up to the bucksaws. In Japan, they all wear uniforms so you don't know who is who, and they bow according to your status. One particular chap who was helping the bucker was really bowing low, so we stopped to introduce ourselves. He was the president of the company. Merchandising was so important to that outfit that the president was out there helping.

It was a big plant. They use three lathes: a three foot, a six foot and a 14 foot lathe. They are able to merchandise the wood because it is long coming from some rather inexperienced buckers down in Malaysia.

If there were any lily pads left over, they ran them through a scoring device, put in scarfs, stacked them up and glued the lily pads together into a three or six foot log and peeled that.

So in a sense, that plant was utilizing 100 per cent of the wood. Those of us in the plywood and veneer business talk in percentage recovery. I don't know what the average is, but we are in the 42 per cent range. They were in the 70 to 80 per cent range. You can see how quickly they get back to a competitive situation on a net wood cost basis.

What we acquired at Williams Lake, in effect, was a merchandising system tied directly to the two plants. It was a very difficult situation to handle. I have a flow chart of what we did back in 1978 when we wanted to correct the situation. With that system, we tried to plot all movement of wood, taking into account species, production centers and the debarking centers. There were 400 possible permutations and combinations there an unacceptable factor if any particular sector was to be efficient. Very quickly we realized the opportunities and planned what action to take.

The inefficiencies existed in terms of productivity, downstream balance, recovery, bucking inaccuracies, breakage and waste handling all the elements of normal day-to-day operation. We decided that first of all we had to ensure a continuing supply of wood to the modernized sawmill that was developing in tandem with this project. Secondly, the plywood plant that was then functional was short of wood and we could not extract enough peelers. Thirdly, we had to match the log diameter to the barkers because of particularly high fiber losses. The whole system involved a capital cost of some 3.2 million dollars and our forecasts indicated a 2.5 year pay-back. It actually paid back at a return on capital in the magnitude of 85 per cent in 1.6 years cash flow pay-back.

In thinking about the new system, the 'least cost' approach was very carefully examined in moving the wood from the landings through to the breakdown centers. The appraisal included the log handling area, barking, bucking and sorting. Secondly, we set out to develop maximum value in grade from the trees considering that price and size parameters were going to change seasonally and as a result of various market

conditions. One vital factor was to balance wood flow so we could control inventory and at the same time provide a balanced volume to each machine center.

The first stage in our procedure was to understand the resource we were dealing with in terms of a five year time frame. In addition, we had to get some volumes by grade and some good data from our woods operations. It is most important to get some idea exactly where your wood is going to come from. We didn't do a forestry inventory for this purpose; we simply took typical cruise data. We utilized the plot information we had on a five year development plan. The key things that we were looking for were the diameters and lineal feet that we were expecting over the next five years. We then took the data and put it into the log profile.

This gave us a printout for the whole volume on all species and all logs, but didn't, at this point, break out the peelers and saw logs. We could then cross-check where we were on total barking capacity and total Chip-N-Saw capabilities; we had to get down to the total lineal feet we were going to be dealing with by various diameter ranges. This was the summary we could use for overall cross-checking. We could also, for the Chip-N-Saw design, use the profile for the computer program on the Chip-N-Saw and this also gave us total barking, bucking and sorting capabilities.

Peelers went to a secondary bucking system attached to the plywood plant. Again, in that particular case, number of blocks and total lineal feet were of prime importance in the design.

We also took a 'least cost' approach in examining the design from the standpoint of wood handling; the extent of the bucking we would have to do in the woods; the extent of sorting; butt orientation; and the impact on hauling costs. We did just a rough estimate as to what those relative costs might be to make sure we were on the right track. As those in the plywood business know, there is always that argument as to whether you buck short logs in the bush. We determined at that point that we were going in the right direction by adopting a long log mode to minimize costs. It looked like about a dollar and a half opportunity in the logging sector alone if we kept to the long log mode.

We also scrutinized the log deck side to equate total cost considering breakage, extent of sorting we had to do, misbucking problems, recovery and waste handling systems. All those factors went into the 'least cost' equation. And at that point we got down to mechanical and engineering work.

Initially we decided there were some basic criteria that required study. First of all, market and production timing impacts between plywood and lumber were too divergent to allow a direct flow merchandising concept. Many of you have seen merchandisers in the U.S. south where they tend to tie all of them to one particular flow. We determined that from the Canadian standpoint there was no way we could do that.

Another criteria was that, right from the day we initiated the project, we started to involve the crew. We put it in very simple terms; that this 2.5 or three million dollars in wood that we were going to save was going to save our jobs, and we all had to work together to achieve those objectives. Then we started an involvement process to extract all the practical ideas.

Another decision was that we would need a log delivery system that would have two primary sorts in the woods. We were very careful to make sure we were tying manufacturing specifications to merchandising and to actual wood specifications. We developed a basic sorting system and a log manufacturing system that could be applied to the woods.

The next step was to take piece counts and related criteria at each machine center. We determined the trade-off there was simply that we had to have production from a mill that was geared to maximizing length of log, knowing full well the technology would come later to minimize the gap in the Chip-N-Saw infeeds. We decided to apply a microprocessor to situations where one could divert the decision-making to the most productive functions such as log infeeds, grade and defect judging, and plug-up and flow monitoring. We used PLC's, encoders and computers in the saw activation gate for conveyor activation and for those functions that would not normally require decision-making.

The other major concern was that we had to provide a productive infeed for long logs into the merchandising system and to balance outflow of the bucked logs. Low clean-up and waste was required, together with a low-cost waste removal system. We told the engineers they would be the first guys to clean up the conveyors if they didn't function. We involved the millwrights right from day one. I would say that a lot of the success of our operation has been because the conveying systems worked well.

From a supervisory standpoint, we put the woods department in charge of merchandising for two reasons: one is to tie it into the wood supply situation very carefully and to avoid not being able to keep the mill fed as can happen when direct log inflow is tied to another department. The other thing that it has done is to make the woods people totally respect log quality, mill balance and other similar problems. So

there has been a positive benefit, but it depends a lot on the ability of people to cooperate.

Regarding training and application of the system, one factor we were dealing with was an employment base of some 17 per cent East Indians, some of whom had been around for a considerable time. Some were older employees who did not speak English well. Rather than go with new staff, we decided to train these people. We used some specialized training programs which we developed ourselves with the aid of a fellow who used to be in the management training field. We used diagrams, special slides and videotapes that they could take home and play or keep in the operators' booths with them. By constant reference to tapes and similar aids, showing the goals we were seeking, we were able to achieve the end result with new technology, even where older employees were involved.

Another problem involved showing the relationship of a control panel to a log in the saws. We tried to keep it fairly simple, using such patterns that could be displayed to operators to get them to relate how to maximize the opportunity from a given log length.

The plywood merchandising system presented a similar situation where we tried to have displays and systems which tied the control panel and sequencing to what was actually happening from a training standpoint.

When we started to use this system, we encountered all kinds of problems and some major difficulties. Log presentation was a key factor in the operation. We had a lot of difficulties there and, again, it was a training problem to get the log yard people to cooperate. The system did not have length scanning at this time. We were able, through some other devices, to get length determination on a more identifiable basis but that, of course, is a problem when you are lateral bucking.

Another point is that since our plywood system takes the peeler, or takes the butts for peelers, the random off-the-top is a saw log and quite often those top logs are not bucked to any specific length. Being able to handle the high degree of random lengths and keep it on a minimum waste basis was a particular problem for us.

Let's take a look at data requirements. At that point we determined that we needed a piece count and found that merchandising for the sawmill was running at about 2250 pieces a shift.

New benefits in the present system obviously include improved recovery. For example, if the log is coming into that merchandiser at 41 feet 10 inches, it will just make two 20 foot logs; and if the quality decision is made for too much trim, it is going to result in an 18 foot log. The length accuracy, therefore, is extremely vital. We are now looking at the opportunities to go to length determination and are also examining the best opportunity for grade and value optimization.

One of the benefits we keep looking for is a return on capital employed. Interestingly enough, it is not that great. In this particular situation, with all the detailed studies, there is far more return on capital in trimmer optimizing and optimizing through the double arbor gangs in our mills; our capital will be going there.

In the plywood bucking systems, the biggest opportunity we see is to be able to somehow equate the woods bucking decision more precisely with the actual bucking decision on the merchandiser. Again, if a mistake is make in trying to duplicate what the woods bucker did, you have, in fact, either put a peeler down to saw logs or you have wasted wood.

At West Fraser, Lejac, they took the basic system, introduced two operators with a scanning system and had extremely good luck. Their piece counts have gone up. They take a rough scan on length to, in effect, four foot scan space. Since they can end the log two feet, they are, in effect, getting a two foot length determination. But this is feeding a stud mill on one side and a dimension mill on the other taking only the butts for dimension. But they basically took the system that we used on our sawmill side, put a scanner over an unscrambler with two operators, and went to three belts and a far more complex gate and sorting system than ours. But they are very pleased with it, according to reports.

I'll now underline some general comments about where we think we are going on log scanning optimization and bucking. We think we need to review the goals. Obviously, optimizing recovery on specific reference data by reducing operator error would still result in major gains. We think it has to go into fairly precise two foot increments in the saw log areas, and far more precise increments on the plywood side. We think also, that perhaps it is going to be after bark removal.

Regarding optimization of markets one thing our lumber people keep saying is that you must get full-car orders. The marketing people will then say that one particular length is 'hot' today, but as you we'll know this situation changes very rapidly. Unless we can work to full-car orders we are going to end up with problems in the yard. Defect trimming is another area that is a real opportunity for technological and microprocessor-based change. Too often we are having to make a decision based on imprecise data without fully understanding what the impact of taking

a one, two or three foot trim off the end of a butt and without realizing what that might do in terms of recovery. We think we can modify some bucking solutions by having a more rapid introduction of market requirements, and perhaps using a downloading system from a remote computer.

Regarding hardware and software, we believe that, in terms of sensing devices, non-visible spectrum scanning using ultrasonics has good possibilities. We would also like to see some full length log scanning, using computer graphics on special cameras. We believe the more you can display to the operator, the more opportunity he has for making a better decision. I think there is an opportunity for a higher rate of log scanning information with transmission by PLC's, which could result in higher piece counts in some situations. This has been proven at West Fraser.

In the software area, this whole business of management data always causes a lot of debate and we've all had discussions on the volume of paper that comes out. We think the real opportunities in management data now lie in some way to establish trend lines; some way that you can relate waste and recovery data more accurately and isolate specific time frames. Another opportunity is to have some way of getting feedback on log quality to your woods department.

In conclusion, a couple of comments on the two types of bucking systems. We are constructing a new mill right now at 100 Mile House. As I have discussed, our system used a lateral bucking system. At 100 Mile House, which is a pure sawmill, we are going with a lineal system. The plywood plant there will not be functioning after the sawmill starts up. We have had a lot of success with lineal bucking at our two operations in Babine and Houston, and the decision was made to go lineal. It does provoke some interesting discussions on whether you go longitudinally or laterally. On the longitudinal, you get a higher accuracy due to better scanning and positioning, but that is debatable because in winter, in our country, you get a lot of bounce, particularly when the log stops. A longitudinal system gives a lower piece count and a lower capital cost in addition to greater space requirements and a higher labor cost.

On the other hand, the lateral system gives you lower accuracy in determining length because you have fixed sampling points in positioning, though you might be able to offset that by better presentation and better singulation. It has higher piece counts and higher capital costs; but it has lower labor costs and a diameter limitation that the lineal system doesn't have. There is a higher degree of bucking accuracy on a multi-saw system in our experience.

* * *

Headrigs: Where They Are and Where They Are Going

Randy Parkes
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The use of microelectronics in the forest industry must be accepted by today's modern sawmiller. Microelectronics themselves have provided us with the tools to assist in analyzing both the need and application of this technology. Mini-computers have allowed us to analyze our sawmill in each critical area of manufacturing, whether it be better knowledge of the resource in the forest, or a better control of inventory of finished products.

Mini-computers used for sawmill simulation have allowed us to discover the vast profit potential in correct sawing solutions for volume or value, the bucking station, the headrig, board edgers, cant gangs, and trimmers, along with the correct positioning of logs, the sorting of rough lumber, savings in drying and planing, and the cost of energy.

We must, however, realize that any simulation will provide us with the ultimate targets, but the actual gains possible will always depend on the level of technology applied or available at the time.

For example:

- Computerized log breakdown simulation can use real time and take three to four minutes for an ultimate solution.
- Sawmill applications require a production need of six to 10 solutions per minute.

Therefore compromises will continue to be made as technology catches up with the need.

My subject is the headrig or primary breakdown machine, where they are and where they are going.

Where They Were

Most sawmills today use the following breakdown machines.

- Two-sided canter (chain infeeds)
- Chip-N-Saw (several configurations)
- Sharp chain systems (canter or bands)
- Conventional carriages

The above machine centers can be enhanced by the addition of some well proven microelectronics such as:

- Programmable controllers to replace relay logic.
- Scanners to overcome inaccuracies of manual sets.
- Linear positioners to replace stacked cylinders.
- Sawyer aids or headrig scanning.

Let's take a short look at the advantages of these items and how they have enhanced the existing primary breakdown.

Programmable controllers

- Replaced relay logic with its inherent maintenance problems.
- Allowed the user to custom design the machine sequencing and control.

Scanners (sawing solutions)

- Have removed the manual sets.
- Have smoothed out the operation of these machines.
- However, they still assume log position, assume log shape, and, in most cases, use a pattern or look-up table configuration (suitable in some applications).

Linear positioners

- Totally programmable (flexibility).
- Accurate (repeatability to .002 inch).
- Fast (speeds up to eight inches per second and faster).
- True example of the evolution of microelectronics in the sawmills (history).

Sawyer's Aids

- Allow pre-stacking of sets (no shims).
- Accurate backstand calculations.

These are true examples of microelectronics being applied to existing primary breakdown systems to improve their productivity.

Where They Are

How have we taken the knowledge provided by computerized sawmill simulation with the advantages of proven microelectronics and applied it to today's generation of primary breakdown systems? In analyzing log breakdown simulation, the most evident in yield (recovery) can be attributed to accurate log positioning and positive log transport.

Log positioning

Because the scanner technology is not yet available to truly identify actual log shape, we still leave this job to the operator and provide him with the proper tools to do the job. For example:

- Feedroll type turners
- Sprocket or stationary turners

This is still a compromise, waiting for technological advancement.

Log scanning

We have advanced to scanning the log after it has been positioned and is being positively transported. This has definitely improved the scanning function, but we are still not identifying log shape, other than some sweep identification. The sawing solutions, because of time constraints, are still of a patterned configuration or a combination of real time and look-up tables.

Because we cannot truly identify log shape and the computer speed is still not applied to allow real time solutions, we continue to compromise in this area.

Positive log transport

This is an area where microelectronics have allowed us to make the greatest advancements. For example:

- Stretch Chip-N-Saw

  Certainly not the ultimate solution, but is a means of identifying log position, compensating for it and at the same time maintaining high production for a relatively low capital cost.

- Full taper infeed

  Again, it is not the ultimate because it has a fixed sawing method full taper; however, it is a very positive transport system which allows us to predict log position and be sure that the log will maintain this position. Again, continues to provide the required production levels at a reasonable capital cost.

- Precision carriages

  These provide us with an excellent transport and positioning device with highly accurate setting and flexible cutting methods; however, throughput is greatly limited and they are only economical where a constant diet of large logs is available

- Side clamp or end-dogging systems

  Either of these systems provides us with the best primary breakdown system available in terms of positioning, scanning, accuracy, and flexibility, but still require manual log positioning. However, at this point the log is clamped by a charger and is positively transported through a dual axis (X Y) scanner. The position in the vertical plane and horizontal plane is identified and the log is positioned for the best open face. A sawing solution, in most cases using a combination of look-up tables and real time, is selected and can vary as to half taper, full taper, center to the pith, or offset. Linear positioners allow us to charge 20 inch diameter logs, 20 feet long at up to 24 inches per second with an accurary of .005 of an inch.

Due to cycle times within these systems, out throughput is limited to three pieces per minute with a reciprocating end dog to six pieces per minute with a side clamp system. If the average log diameter is large enough, these piece counts will provide the necessary production.

The side clamp system and end-dog systems are large, sophisticated and expensive; however, they do provide us with the best possible primary breakdown systems available today.

It must be noted that all of these systems:

- Stretch Chip-N-Saw
- Full taper canters
- Precision carriages
- Side clamp feeds
- End-Dogging Systems

use state of the art, scanners, mini-computers, programmable controllers and linear positioners.

Where Are We Going?

To remain profitable in the future, it is required that we recover all of the lumber available in the log and maintain accuracy and high grade wherever possible.

Feed systems

With the concept of the side clamp and the end-dogging, we have provided the basis for mechanical design of the headrig of the future; however, we will have to continue to improve the speed of positioning and decrease cycle times to increase production capacity. This is possible with the development of microelectronics.

Log scanning

This is an area where the greatest advancements must be made. We must be able to identify the actual log and all of its shapes and defects in all planes short of growing square trees. This is the only way of truly optimizing the log.

Log positioning

Once we have identified the actual log shape, the headrig of the future will be required to position this log in an optimum manner. It is evident that robotics will be required in this area.

Sawing solution

The sawing solution will require a real time process to develop maximum recovery from each log in terms of volume or value, boards or cants. This solution will also be required to consider defect as described by the scanners. This system will not be available for six to eight years, but smaller steps can be made to increase recovery.

After we have scanned each and every bit of the log and identified its actual shape, used high technology to solve the breakdown problem in real time, and applied robotics for log positioning, we simply have to accurately transport that log at a rate of 10 to 12 pieces per minute.

The ultimate in log breakdown might never be possible. However, microelectronics has enabled us to establish targets, enabled us to advance towards these goals and will continue to aid us in the persuit of total integrated optimization.

* * *

Edger Optimizers With Grading Capability

Grant Maxwell
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CAE Machinery Ltd., Vancouver, B.C. and Ahlstrom, Finland signed a joint manufacturing agreement in April 1981. This agreement gives each company access to design and manufacture each other's sawmill machinery. The first product which CAE Machinery will be manufacturing and marketing for North America is the Ahlstrom board edger optimizer.

Ahlstrom first developed the board edger optimizer in the beginning of the 1970's. This was to become known as the transversial edger optimizer, meaning the board is scanned and moved sideways or transverse into the edger centerline and processed.

Then Ahlstrom developed the longitudinal board edger optimizer. Continuing research and development has contributed to the addition of the grading attachment to this optimization machine center.

The following outlines the advanced technology in use in Scandinavia and how it adapts to North American needs.

The complete machine center comprises the unscrambler, the cross conveyor, the infeed line through the scanning zone, then through the chipping or saw section, out onto the outfeed line. With this machine the board is no longer required to be placed in an optimum position at the infeed line mechanically. It is just centered. Scanning is done during the infeed transporting of the board through the machine and the chipping or saw section is set at optimum position without moving the board sideways.

Boards are initially transported through the unscrambler, cross conveyed and presented wane side up to the edger optimizer. The board stops at the top of the unscrambler to be grade limited by an operator. The grade cannot be evaluated if the wane side is down; the board must be turned over first, then grade limited.

The cross conveyor begins with a pass/turn/reject station. The operator either passes it, turns the board or removes it from the proces . In removal, the turning arms are left open and the board falls through the opening onto a belt conveyor. The boards can then be designed to go to other chipping edgers, waste-wood chipper or in the case of a badly twisted board, set aside for a separate edging at the end of the shift. Now the board is on the cross conveyor wane side up approaching the scanner infeed zone. The board is then pushed with scissor arms into the scanning and edging line. After centering and the arms released, the board is locked against a continuously running chain by eight rubber coated pressure rolls, then transported towards the board edger.

As shown in Figure 1, scanning is performed by solid state cameras utilizing a matrix imaging device. The illumination is provided by an LED linear array. The array 'shines' a line on the board which is 'seen' by the camera. During the longitudinal transport, the board is measured by three cameras. The distance between the cameras depends on the maximum length of board to be scanned. For a 20 foot board, the distance is seven feet, and when the board is moved seven feet it is measured entirely. The camera is in a dust tight enclosure, looking at the mirror image of the board which is beneath this section.

Computer Considerations

After complete scanning and as the board is still moving toward the edger, the computer analyzes the

best possible edging method and sets the chipping or saw section accordingly. The computer considers:

- Length
- Width
- Thickness modules
- Prices of various grades and chips
- Wood species
- Production program where certain grades and dimensions are not wanted
- Permitted wane

The computer sets the chipping or saw section to optimize position. They can be set symmetrically or asymmetrically to the feeding line. If the board is to be edged asymmetrically, the centerline of the edger will be moved in relation to the feeding line.

The Optimizing Principles

According to the scanning data and the operator's impulses, the computer will perform the following tasks:

- Check the data. Non-logics are signalled to the operator with a warning light.
- Check all the permitted grade and width combinations for the thickness and calculate a value for every modular length.

Computer Calculations

Considered in the calculations are:

- Prices of different grades
- Prices of chips
- Wane permitted
- Minimum length of board
- Wood species
- Grade
- Width and thickness combinations that are not permitted
- Skew angles

The computer then gives:

- The size of the optimum board and the needed centerline correction
- Parallel and diagonal edging decisions

The computer will further check if the board is already optimal for an edged board. The chipping or saw section will be driven wide open for a pass through. It will tell the setworks the required set and display the edging results, grade, width, length, code.

The operator sits adjacent to the top or the peak of the unscrambler section. This is the location where he makes the decision on grade. With the grading attachment package available from CAE/Ahlstrom, that decision is no longer made here by the operator. A grade decision will be made at the optimization stage in the scanning section. The operator's function here is to ensure the wane is presented properly to the scanning section, and in this case the board is wane side up, or to reject pieces not suitable for edging. The other function of the operator here is to maintain continuity in flow through the use of his unscrambler feed controls.

The grader package is shown in Figure 2. The grader package itself consists of:

- The optimizer processor
- Grading processor
- Grade and volume scanners
- Ahlstrom edger optimizer

As shown in Figure 3, the grade scanner uses a helium neon laser source for board illumination to provide surface penetration which increases grade reliability, i.e. it ignores marks in the board not associated with grade. The illumination line is viewed by a camera in a fashion similar to the optimization scanner. The grade computer processes this information and provides the result to the optimization computer.

Stress Rating Optimization

Figure 4 shows the structure of Finnograder stress grading machine center. In connection with the increase in industrial manufacturing of wooden frame houses, truss rafters and glulam beams, the economical use of wood as a raw material has become more and more important. As with any constructional material, such as steel or concrete, one must be able to base the design strength on known maximum allowed stresses. Without individually measuring the strength

of each piece of timber this is not possible because of the non-homogeneous nature of wood.

The pieces are fed lengthwise through the Finnograder measuring station. Gamma-ray, microwave, and infrared sensors controlled by a microprocessor measure the density, knot content, slope of grain, moisture content and temperature of the piece while it is moving. On the basis of these measurements, the Finnograder computes the strength of the piece from end to end according to a strength formula.

The Finnograder measures the board's characteristics and computes the strength of each inch. The resulting figures are used in automatic sorting, marking of the strength grade, marking of the strongest edge, as well as dye marking the strength of each inch.

The Finnograder displays the strength of the whole piece and the strength of each inch. In addition, the Finnograder also displays a continuous production report including counters for each grade. Through tests, the condition of the equipment, especially that of the sensors, is automatically and continuously controlled. When a serious fault or defect occurs, stress grading is automatically disabled.

Finnograder System

Both sensor cabinet pairs move automatically in a horizontal plane to the centerline of the board. Cabinet pair No. 2 (see Figure 5) glides automatically in a vertical direction so that cabinet pairs No. 1 and No. 2 are positioned symmetrically with respect to board faces.

A conveyed speed sensor is coupled to the conveyor. Through the sensor the Finnograder determines the movement and speed of the conveyor and the piece. The board end detector in sensor cabinet No. 1 reports on the entering board. Thereafter, the board characteristics (density, knot content, slope or grain, moisture content and temperature) will be measured.

The pieces are fed into the Finnograder measurement station, e g. direct from a planing machine. Strength grading can be performed before or after planing. Visual stress grading is carried out either before or after the measuring. A dye marker can mark the strength of each inch with a color code. The strongest edge of the board is marked with a color code at the second end of the piece. The strength grade of the piece is marked through the whole length of the piece.

Density Sensor

According to the strength formula, the density of the board is a decisive factor in determining the basic strength of a piece. The other characteristics are used for adjusting the result. The density measurement is based on gamma radiation attenuation. The sensor is self-calibrating. The sensor measures the actual weight per area. The density is calculated on the basis of the weight per area and the thickness entering by the operator. The effect of moisture variation on the density is taken into account when calculating the final density.

All density values are normalized to 15 per cent moisture content. When the width of the piece is less than six inches, the density is measured at the center of the board; when the width is more than six inches, it is measurured symmetrically on both sides of the centerline.

Knot Sensors

The Finnograder measures the knot content twice, each time with a separate sensor. According to the dimensions of the board, the sensor cabinets are automatically positioned so that the knot measurement is performed symmetrically in relation to the board. In the first measurement (cabinet pair No. 1), the microwave transmitter is placed over the piece and the receiver under the piece. In the second measurement (cabinet pair No. 2) the transmitter is placed under and the receiver over the piece.

Thus the information gathered about the knots (including their size and geometry under the surface) is as complete as possible.

The knot sensor, consisting of microwave transmitter and a receiver, is automatically calibrated. The knots cause a phase shift in the penetrating microwave field that is measured with the microwave receiver. The knot signals are processed according to the strength formula, whereby the place and the size of a knot are duly accounted for.

Slope of Grain and Moisture Sensor

The slope of grain and moisture are measured with the same sensor. They are both determined from a five inch wide sector around the centerline of the piece. The change in polization of the microwave radiation is used to calculate the slope of grain. The moisture content is calculated from the attenuation of the microwave radiation. The sensor automatically calibrates between boards.

The temperature of the board is measured with an infrared radiometer. It measures the surface temperature of the piece. The surface temperature

must not differ from the core temperature more than 10°C (18°G).

The standard dye marker marks the grade on the flats at two inch intervals with one of five colors (four grades and reject). It also marks the stronger edge.

The optional stamping device makes the grade corresponding to the lowest strength appear throughout the board. This device, as well as those above, can conveniently be connected to the electronics cabinet by using the standard outlets there.

Board feed speeds of up to 320 feet per minute have been achieved.

Finnograder Applications

In summary, the basic application of the Finnograder is stress grading, marking and sorting of pieces of timber to be used for construction purposes.

Many countries have their standards for machines in stress grading. These machines have to be officially approved. In Europe, grading is based on predicted MOR (modules of rupture) on edge. In Canada and in the U.S.A. pieces have to fit a certain MOE (modules of elasticity) on edge. As the strength prediction has more or less variance depending on the used machine type, species, etc., grading limits are usually set so that five per cent of pieces are allowed to be graded below the limit. This means that the official body that approves these machines makes a series of tests where pieces are measured with the machine and then actually broken. The grading limits are set then with a five per cent rule and are kept constant.

In North America, each plant has a proof-loading machine after the stress grading machine and by following strict rules users can change grading limits according to the measurement results of the proof-loaded samples.

* * *

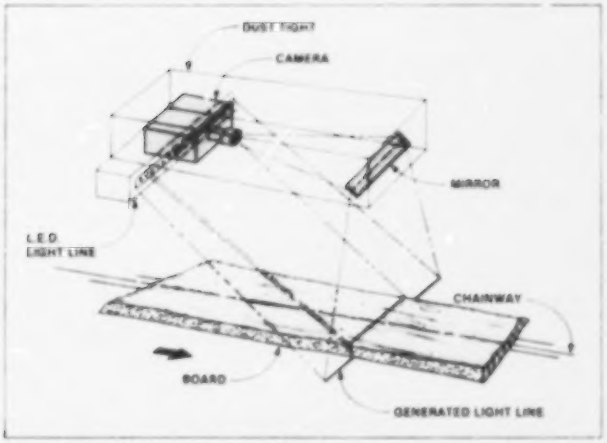
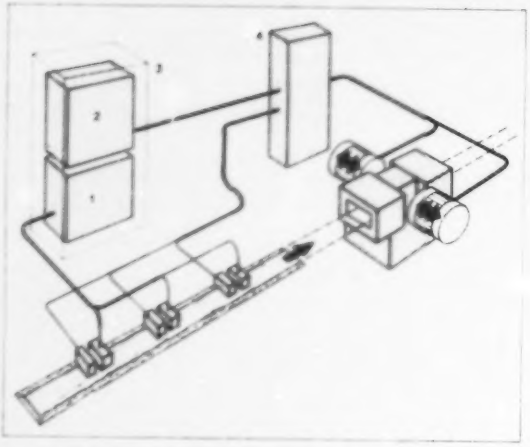


Figure 1



1. Data processor
2. Grading processor
3. GRADER-E
4. Ahlstrom edger optimizer

Figure 2

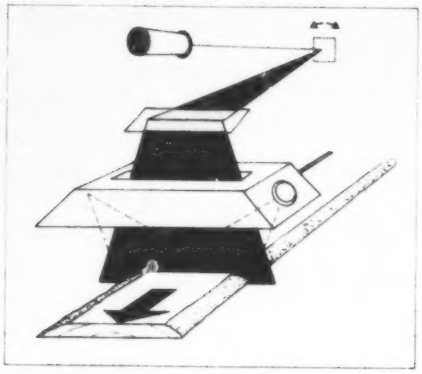
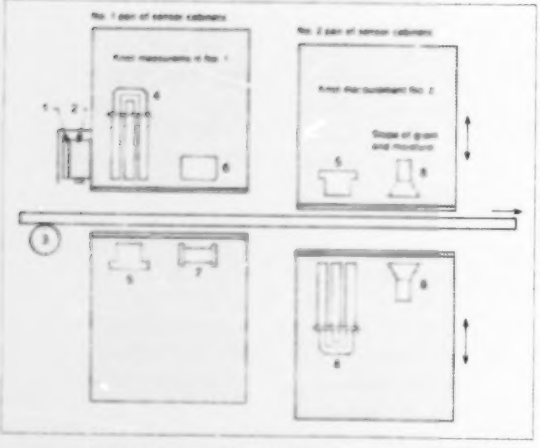


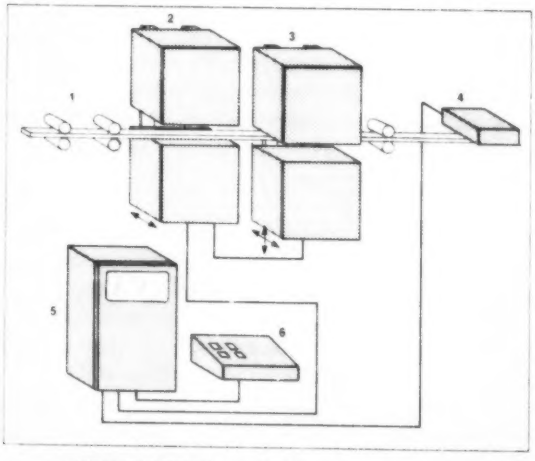
Figure 3



FINNOGRADER SENSOR ARRANGEMENT

1. Board end detector
2. Surface temp. sensor
3. Conveyor speed sensor
4. Microwave transmitter
5. Microwave receiver
6. Density Gamma ray source
7. Gamma ray detector
8. Microwave transmitter / receiver

Figure 4



FINNOGRADER SYSTEM ILLUSTRATION

1. Conveyor
2. No. 1 pair of sensor cabinets
3. No. 2 pair of sensor cabinets
4. Dye marker
5. Electronics cabinet
6. Control desk

Figure 5

Sorting and Control Systems

Eric Swan
Research Scientist, Forintek Canada Corp., Vancouver, B.C.

I am going to discuss color identification tests for Douglas-fir and spruce-pine-fir from the Interior. When I say fir, I mean what in the trade is referred to as 'balsam'. I try not to call it that because the true balsam fir grows in eastern Canada; the true common name of the fir we have here is alpine fir.

The first test that we started with was one to separate Douglas-fir from spruce. For this we have an indicator agent which turns the Douglas-fir a yellow-orange color and the spruce turns a greenish-yellow color. This reaction is fairly fast and this is a simple chemical test. The spruce reacts by turning a greenish color. I have different test for pines which are slower developing the color. Finally, I have a different color test for 'balsam' as most people call it. It works very rapidly in knot wood. The rest of the board will change color but more slowly. The chemicals responsible for these color tests are compounds in the wood called extractives which are present in very low concentrations. Extractives are natural chemicals which give each wood species its character and which are different from species to species.

When I was first asked if I could come up with a test for Douglas-fir, I couldn't believe that a chemical test was necessary. Even to the untrained eye, they are easily distinguished but the point is that you want to tell them apart at production rate speeds. If your quality control man is looking at 25,000 to 30,000 pieces per eight hour shift, he has a hard time telling spruce from Douglas-fir at the end of the shift. He starts off being 100 per cent correct the first thing in the morning, but after eight hours every piece looks the same. John Mushaluck of the Weldwood mill in Quesnel has been using this Douglas-fir sorting system as a visual aid to his sorters for about four years now.

The pine and 'balsam' color agents that I have discussed are slow to react. Color depth and reaction speed are some of the characteristics of a good identifying agent. Table 1 summarizes these properties and others.

The speed of reaction must be very fast. The reagent must be useable in a mill which is perhaps sorting them at 60 pieces per minute and has about 10 to 15 seconds between the time the agent is applied and the time that the species sort is done. It has to be effective at temperatures of 30° below in the winter time, and up to 30° above in the summer time. The Douglas-fir reagents are the fastest, the pine is a little slower and the alpine fir, 'balsam', reagent is even slower than that.

The reagents must also show a positive reaction with that species and no other one that could be in the lumber mix. One problem with the Douglas-fir reagent is that there is some interference by decayed pine heartwood. The Douglas-fir reagent reacts with acidic extractives in the heartwood and some of these compounds are formed in the decayed pine wood so this wood has to be sorted out first if it is present. The specificity of the natural pine reagent is poor, because it generally reacts with all phenolic compounds and similiar compounds are present in the Douglas-fir. If the Douglas-fir is sorted out, then the specificity of the reagent is better. The specificity of the 'balsam' agent is good. Only the 'balsam' reacts with it.

The pot life of the chemicals is very good. The Douglas-fir reagent can be mixed-up beforehand and will last for one shift or more. The pine reagent must be used as solutions and pre-mixed just before they are applied on the wood surface, and the alpine fir or 'balsam' reagent pot life is intermediate between the other two. The chemical costs are in the ratio of one, two, three. If chemicals for the Douglas-fir reagent cost $10 per shift, then the reagent for the pine cost $20, and the ones for the 'balsam' are going to cost $30.

The toxicity and corrosiveness of these reagents will also have to be considered. There is no problem with the Douglas-fir reagent. It does have a little alcohol in

it to solubilize it but it is not really a problem. The 'balsam' reagent is not a toxic chemical itself, but it is very corrosive because of the very large amount of acid in it. This will, if you spill it on your greenchain, dissolve the greenchain. So you don't want to splash it around, but this is not to say this is a problem which could not be solved. We could apply the reagent to the wood, sort it as to species and then neutralize the chemical after it is sorted. Also, the pine reagent contain dilute acid and the same considerations apply. It is not very toxic and it is rated as 'human indefinite IARC' in cancer-causing ability.

In the sorting system based on these reagents, spruce would be the one wood that does not react. It would be nice to have a reagent that was specific for the spruce, or better still, to have a universal reagent that you just sprayed on the pieces of wood and they turned red, white, and blue and that was spruce, pine, and fir.

* * *

Table 1
Characteristics of Identifying Reagents

Property	Douglas-fir reagent	L. Pine reagent	Alpine Fir reagent
Speed of reaction -30° to + 30°	10 Sec.	30 Sec.	60 Sec.
Specificity	Good[1]	Poor[2]	Very good
Pot life	Good	Poor	Good
Chemicals cost	1	2	3
Toxicity, etc.[3]	None	Possible	Corrosive

[1]Some interference by decayed pine heartwood

[2]Okay if the Douglas fir is sorted out first

[3]Also flammable in some recipes

Lumber Recovery Improvement Through Automatic Size Measuring and Monitoring

Dave Carlson
Trienco Automation Systems Company
Vancouver, Washington

The recent market downturn has proven challenging to even the most able management. Yet the farsighted individuals in our industry have made moves to counter these effects and, in fact, convert them into opportunities. Significant profit leverage has been extracted in the most truly competitive business going the lumber business. The successful lumberman implemented change to increase recovery. Among other areas of yield improvement, sawing accuracy gained much support as an area of significant profit impact.

The very successful Forinek program and the sawmill improvement program for the states of Oregon and Washington show in their studies that recovery improvement opportunities exist in the magnitude expressed in Table 1.

John White, among others, studied the relationship between set reduction, sawing accuracy, and lumber yield improvement1. Significantly, as sawing accuracy increases, the yield increases at an exponential rate. In other words, as accuracy increases unit by unit toward zero variation, the increased yield for each unit is greater than the preceding unit.

Realization of the opportunities in controlling sizes led the industry into more sophisticated means of measurement and analysis. In order to reduce sizes and control variation, it is necessary to first measure and analyze for cause then monitor to assure compliance to achievable standards.

In 1974, the Trienco research group was directed to commence with a research program which would ultimately provide the wood fiber conversion industry with a reliable and accurate on-line measuring device. The concept of the device defined that it would accomplish the measurements without contacting the product and provide a sense device to product distance of at least four inches. The equipment was to have no moving parts, sample at a rate of at least 500 samples per second, provide a minimum accuracy of 0.005 inches over twice the product thickness range, generate control functions based on mill parameters and require no technical knowledge for the parameter input. Accuracy would not be affected by vibration or product bounce and would continue to function reliably in a mill environment.

The reasearch program culminated in the development of a sophisticated new sense device and, subsequently, in a full equipment package which met or exceeded the intial requirements in all areas.

The Trienco model 1000 thickness gauge is packaged around a building block concept, whereby the basic system may be custom tailored to a specific requirement with plug in modules.

Each measurement zone is an independent subsystem providing flexibility and reliability. A low power laser and associated optics precisely locate the product surface(s) for each measurement zone. The equipment may be used in the single side configuration in which only one surface is electronically monitored. Thickness is gauged in this mode as the distance of the product surface from the reference surface. Although this configuration is somewhat lower in cost, it has inherent inaccuracies due to the mechanical reference

surface involved. A very careful cost function analysis should be made prior to selecting this mode of operation.

The differential configuration provides excellent accuracy on a totally non-contact basis. Accuracy is not affected by product bounce or mill vibration. Each differential measurement channel employs two sensors mounted directly opposite one another. Distances to the top and bottom surfaces are measured at a high rate of speed, ranging from 600 times per second to 4,000 times per second, depending on the application. The distance measurements are computed into absolute thickness measurement data used directly as a control function for sorting, board marking, etc. For size monitoring, direct interface into a digital computer has been found most appropriate.

The memory capabilities of modern computers prove invaluable for providing prompt, concise information. When so programmed, printouts may be provided which readily show sawing accuracy expressed as histogram displays of nominal size distributions. Programs are available to identify total variation, board to board variation, sawing variation, lumber tally, etc. When used with CRT display, average thickness, percentage out of tolerance, or other appropriate statistical measurements are displayed using circulating memory technique which continually updates showing only the data for the last 250 boards.

This approach provides on-line control indicating immediately to the mill operator when an 'out of control' situation exists.

The advantages of automatic measurement are reasonably obvious. Random sampling techniques require people and provide limited control value when done on an infrequent basis. When automatic measurement of 100 per cent of the lumber occurs, there is little room for doubt. Minimum target sizes may be instigated with confidence, as the sampling error is essentially zero.

In conclusion, 1982 proved that techniques, equipment, and control systems which improve recovery were essential for operations to remain competitive. A quick look at the timber-short European countries would indicate that optimum recovery will be the name of the game in the future.

[1]White, John. 1978. Modern Sawmill Techniques. Volume 8, Miller Freeman Publications.

* * *

Table 1
Opportunity Areas

	Percent	$ Opportunity in 100MMBR mill annually
Harvesting	7.8	$1,560,000
Log trim	2.5	500,000
Saw kerf	2.33	466,000
Size	3.33	666,000
Headrig	7.5	1,500,000
Edgers	6.0	1,200,000
Trimmer	5.0	1,000,000

Computerized Kiln Controls

Part 1

Graham Mackay
Research Scientist, Forintek Canada Corp., Vancouver, B.C.

The subtitle of my presentation as shown is Advances in Kiln Control and Advanced Measurement Systems. In fact, most of what I have to say relates to the first of those, namely advances in kiln control. Basically I want to review where we are today or where we were until very recently in this area, and in so doing perhaps identify some of the areas where we are deficient and where we can use some different technologies.

Let's assume that in your mill you have a new kiln operator, and you provide him with a reference text dealing with kiln drying. Very quickly he will come to a section that will deal with schedules. The schedule tells him what conditions of dry bulb and wet bulb to use for a particular species and for a particular size of lumber and for how long to leave that lumber in the kiln. It makes no reference to the condition of the wood, by which I mean specifically, the moisture content of the wood. It makes no reference to the size or shape of the kiln or to the shape or size of the load in relation to the kiln. Likewise, it makes no reference to the air flow or sticker size. It tells him only temperature and times. And until very recently he would typically operate the kiln using a vapor filled, pneumatically activated controller. This type of controller is very slow to respond in that while you may appear to have very good control of the kiln by virtue of straight line on the recorder chart, a more sensitive measuring instrument would indicate temperatures were up to 15 degrees on either side of that line.

Rigid time-based schedules are adequate provided that the lumber going into the kiln is essentially the same charge after charge. However, particularly with respect to the SPF group, we find varying proportions of the three species. Additionally, we have mixtures of sapwood and heartwood with varying levels of moisture content and ease of drying. We have mixtures of green lumber with air-dried lumber, and now mixtures of green lumber with bug-killed and fire-killed lumber. These are good reasons not to use a very rigid time based schedule. We therefore need a drying system that takes account of the state of the wood in the kiln, and it must be sensitive to the properties of the wood. Several attempts have been made to do this. The majority of them are computer assisted or controlled and these are what are now described.

Of the eight examples, some are widely used, while of others there may be only one or two examples. Gann, Hildebrand, Lignomat, and Bollmann are German, Utec is Swedish, the Potlatch and Union Camp Companies in the U.S. have developed their own systems, and, finally, there is the B.C. product, the Frank Controller. The German systems are essentially similar, using the same basic principles. Basically, they use an extension of what you recognize as a resistance-type moisture meter. Probes are inserted in a selected number of boards in the kiln and an attempt is made to measure the moisture content of that wood by a moisture meter in the kiln control room. That data is input that can be used in a computer assisted system.

One other pair of sensors is used to measure the EMC or the moisture content of a wafer of wood, or a wafer of cellulose which reacts very rapidly to changes in the kiln and gives a very good measure of the EMC.

The computer or microprocessor is set to run to a prescribed schedule, which instead of being given in terms of dry bulb temperature and wet bulb temperaturess actually works on the basis of the ratio between the measured EMC of the wafer of wood and the measured average moisture content of those boards in the kiln that have the electrodes in them.

There are some limitations to this system, however. One is that a resistance type moisture meter is accurate only at the fibre saturation point (25 to 30 per

cent MC) or less. Close control of the kiln is therefore only obtainable in the latter stages of drying when the wood is down to about 25 per cent or less. Secondly, the very presence of electrodes in the boards can itself be a problem due to an additional contact resistance set up in the wood. Thirdly, care is required in the selection of boards from a charge that will be representative of the total charge.

The Swedish Utec system, of which we are now seeing one or two in B.C., is a rather interesting one. First, the kiln operator answers a set of questions posed to him by the computer with regard to the state of the wood going into the kiln. The computer asks, for example, for the species, the size, the volume of wood in the kiln, whether it has had any air drying, whether there is to be a conditioning period at the end of the schedule, and what the final moisture content is to be. After getting all that information, the meter selects one of a number of pre-programmed schedules which it thinks best suits that wood and the way it is to be dried. During drying it measures the air temperatures on both sides of the load and the humidity throughout the kiln, and by application of a number of mathematical equations, it carefully controls the operation of the kiln to follow the schedule that has been set.

The Union Camp Co. system was developed at one of its mills which was faced with a problem of warp due to overdrying of lumber. It was recognized that in order to control the degree of warp in the loads, far tighter control of the kiln was necessary. The kiln they developed is capable of controlling the temperatures in 12 different zones along the length of the kiln and up the height of the kiln. Based on a supposition that if they could control the rate of drying throughout all 12 zones to be the same, then moisture content of all the lumber at the end of drying would be the same. Moisture content is inferred by assuming that the rate of drying is related to the temperature drop across the kiln. That is, by measuring the dry bulb temperature on one side of the load at one point and then the exact opposite side, the temperature difference was an indication of how fast the wood in that zone was drying. Thus this kiln, via a computer, is controlled for drying at essentially similar rates throughout the total load.

While on the subject of kiln uniformity, I would like to describe a service to industry provided by Forintek that we call kiln evaluations. We send a team of people to mills that request this service and we very thoroughly instrument the kiln to measure air flow on both sides of the load, along the whole length and up the side of the loads at over a hundred locations. Throughout the whole drying period dry bulb temperatures are measured on both sides of the load at regular intervals along the length of the kiln. We examine accuracy of kiln control instruments, and we measure the moisture content of dried lumber selected from locations where problems were found to exist. Our report to the mill includes recommendations for any changes or repairs that are required.

Two examples of problem areas are described to show that no matter how good a computer based system may be, if the kiln itself is not in good shape there is little chance of success in drying. First, one kiln had air flows from 60 feet per minute to 850 feet per minute. This we found to be not uncommon, particularly in line shaft kilns. So, clearly some upgrading was required. In another kiln where we were measuring dry bulb temperatures, there was a 50 degree spread end to end. So, again, any control system that was operating, perhaps by measuring the temperatures just at one spot along the length of the kiln, would have little chance of success.

The Frank Controller, to be described by another speaker, also measures the temperatures across the load. In addition, it computes the relative humidity and the EMC in the load.

* * *

Computerized Kiln Controls

Part 2

Don Yorston
President, QM Industries Ltd., Prince George, B.C.

QM Industries has a research and development division called Frank Controls Limited which is involved in the manufacture of kiln controls. QM started out in the dry kiln field putting thermal oil into numerous dry kilns and looking at proposals for generating more such business.

One of the things that we noticed working in the field with different kilns was the fact that users all seemed to have different views on operation, scheduling and temperature levels, none of which were very consistent. We found that there was a tremendous variance in the quality of lumber and the amount of time it took to dry. This led us to believe that as part of our approach to drying lumber with thermal oil we should look at the kiln control.

At that time we had an associate, a consultant, who had an idea which involved drying lumber using relative humidity It was his idea that if you put lumber in the kiln and turned on the heat you were going to get some moisture coming out of that lumber. By measuring that moisture across the load, it should be possible to determine what's happening with the wood and to subsequently develop some type of effective control system.

Based on some of these original ideas, we built a computer control. Basically, it was a Z-80 computer and we assembled all the hardware. At this point we had to find somebody that would be interested in allowing their kiln to be used for tests. Drying lumber is something that can result in costly errors if you don't know what you are doing. The kiln that we originally worked in was quite old, one of the older kilns in Prince George, but in very good shape. It was located at the Rustad operation.

On looking at what we've done since, we were very fortunate that we started at this operation because their lumber piling was good and the kiln was in good condition. If we had started at some of the places we worked at since, we would have quit before we got there! After we worked for some time, we installed the control in August of 1982, and worked for about four months. We weren't really doing anything that was really substantially better and in a lot of cases we were possibly a lot worse than the system used up to that date.

Dry kilns right now are run by fairly simple instruments. Basically they look at heat temperatures plus or minus five degrees and makes some control decisions over fairly long periods of time. Sometimes it's not really clear just what benefit a computer will bring. Once we saw that the original idea really didn't do what we thought it would do, we were in the dark and stumbling a bit.

In about October of 1982 we started getting some very good results at Rustad's on that one kiln. One of the biggest factors we noticed was that by running the kiln in one direction, reversing once, using a fairly high humidity and controlling the venting we found that we reduced the amount of gas a little bit, though not by very much. But the one thing we did notice was that the wood started to look of better quality than the wood being dried before. It looked more like air dried wood. So after we'd done quite a bit of work and tried a few charges, they did some tests in the planer mill and determined that the wood was of better quality and ordered four more kiln controls. That kiln only had 6 million BTU and was a fairly large unit. I think they put 250,000 board feet into the kiln.

It didn't really tell us everything we wanted to know about what other conditions we could get, so we went to West Fraser, Quesnel, and we put a control in there.

The four at Rustad were shipped at the same time as the one that went to West Fraser. West Fraser had a kiln of about the same capacity as Rustad's—about 250,000 board feet—and it had about 15 million BTU and was a vintage Cruickshank unit, a block kiln with fair air circulation and good heat distribution. There again, we were lucky that the piling was quite good, the baffles were efficient and things subsequently worked out very well. We got some very spectacular results at West Fraser, based on reducing the time they were in the charge by 25 to 30 per cent. They did some trim tests in the mill and these showed that they had a reduction in trim loss of about five per cent

based on comparing 'our' lumber with some other lumber that they ran in the kiln using their conventional control.

Another point noticed was that their Number Two and better increased by about three or four per cent and they had actually put in meters to measure gas. After the first charge, the management said, "to hell with the gas". Obviously, where this system will pay for itself is in lumber quality. Based on running this unit for quite a while, they bought 22 dry kiln controls.

At this stage of the game, and even today, we are still in a 'prototype' situation. We have really only been at it for two years at this point and I think in a week we sold something like 40 controls. We put in a number of kiln controls in a variety of places and we found out that it wasn't really magi They didn't really work everywhere for there are a lot of problems involved in drying lumber.

At this point we'll examine just how the kiln control works. We heat up the kiln under a controlled humidity and control the humidity as the kiln comes up to temperature. We look at the relative humidity on one side of the kiln and the relative humidity on the other side and the temperature difference. We're working on the idea that if we can get a flow of the free water out of the lumber without doing any case hardening we will actually be able to remove that lumber without putting any stresses on it and without using any extra energy.

Our kiln control measures in tenths of a degree and makes control decisions every second and a half or two seconds, as opposed to a standard control which would measure plus or minus five degrees and would make a decision every two or three minutes. With conventional controls you get a nice, smooth temperature curve, but in actual fact the heat is really going up and down. It's just the pneumatics in that control that make it look level.

So that computer would very accurately measure the temperature and humidity difference. What we would do is continue to give the load heat until such time as we noticed that we were getting less moisture on the other side. When we could see that we were starting to get less moisture, we would then back off on the heat.

The drying pressure that you're getting in the kiln is really a function of the heat, the relative humidity and the velocity of the air. If you keep increasing the temperature in the kiln and you are trying to evaporate the water away from the face of the board at the same rate that it's transfusing to the outside, you've got the water coming out of the board and you've got dry air coming to take it away. If those two rates are similar then you'll get efficient drying and you won't case-harden the wood. What will happen is that if you increase that heat a little bit more, all of a sudden you'll start taking away more moisture from the face of the board than is actually developing and you will start to case-harden.

When you case-harden the board it becomes too dry and that dryness has the effect of preventing more moisture coming to the outside, making drying more difficult.

In actual fact, the process is a lot more complex than that, but in reality that is more or less the principle of what we're doing. We're really looking at that humidity and temperature very carefully and making control decisions based on what is happening across that board in terms of temperature drop and relative humidity.

We then run the kiln in one direction. We don't have any idea when we put that lumber in there exactly how long it is going to take to dry. We don't make any measurements of the initial moisture or ask any questions or indicate what species is involved. We just put the lumber in and turn on the kiln.

As the kiln comes up to temperature and starts to run, the computer looks at the data that's coming back out of that kiln and that is where we get what we call the 'closed loop'. That is why we are using the computer.

At this point there is quite a lot of data, the computer is looking at that information and it more or less decides what to do from that. The schedule that you get is completely a function of what you put in the kiln. If you put bud-killed wood in it might come out in 17 hours or if you put in very wet wood it might come out in 38 hours. It depends on how much heat you've got.

The kiln control will work regardless of whether you've got high heat or low heat because if it calls for heat and there is no heat there, well then it just won't dry as fast as it could. If you have more heat, the control would dry faster, but if the heat's not there it can't use it. Really what happens at that point is that we run that kiln until the data tells us it is time to make our one reversal. When we reach that point we reverse. If it came out in 32 hours, we'd run, say, 26 hours one way and six hours the other. Once the kiln control is balanced for the kiln and we have the parameters set, the lumber will come out dry. The kiln will shut down and it will be balanced from side to side.

One of the problems is that there is a lot of information about exactly what happens in the kiln that we are still discovering. In some cases we've gone into people's kilns and put in one of these controls, thrown the switch and walked away and the lumber

comes out fine. The times are good and the energy is down and everybody is happy and it's just great!

We've been working since June on a kiln at Burns Lake. We are now at the point where we can say that we understand what's happening there and we are starting to dry lumber. It is a very complicated process, and a Frank kiln control is still really a prototype. It is still something that is being developed. One of the factors that is really important is that the kiln operators have to be involved with what we're doing and why we're doing it.

Briefly, some of the snags we've found that have really held us up in drying lumber include a variety of possible conditions. These include: air leaks between kilns where you've got kilns that are all tight together, and the air is leaking from one to another, and you can't see it because it is going into the kiln next door; poor velocity around wet bulbs; no chimney in the lumber; kiln leaks; vents that don't close; kilns that either don't have baffles or the baffles don't work; kilns that have missing fans or fans that are wired in backwards; and kilns that don't have water in the wet bulbs.

Right now we have about 24 of these kiln controls in and working and we've got another 10 or 12 that we are in the process of installing. We've still got five or six controls that are in kilns that don't work. At this stage of the game, we have really whittled it down. We now know when we put a kiln control in whether it's going to work when we start it up or not. If we can get rid of a lot of the problems in the kiln ahead of time, then we know it's going to work.

Some of these problems can be dealt with in the control. For instance, leaks in the kiln aren't completely fatal. The control can allow for that. It just makes it tougher to put the unit in and make it work if you have a kiln with a lot of leaks. Some of the things we are starting to get into as well include putting multiple bulbs in the kilns.

Instead of just measuring in one place across the loads, this computer is fairly powerful and we can measure in as many as eight zones down the kiln. At this time we are only doing two because we seem to get a fairly good balance in most kilns with just one and I think two is going to pretty well pick up the ones we are having trouble with on a balance from end to end.

I think the biggest advantage of the Frank kiln control is the fact that once you've got it in there and you've got it working, it is really easy to operate and is very consistent. It takes the operator error out of drying lumber. That is a very important point because training dry kiln people doesn't seem to be a high priority. There seem to be a lot of untrained dry kiln people out there, though we have found them to be extremely cooperative to work with while not being very knowledgeable. Essentially, from charge to charge, you put the lumber in and you push the green button that says 'start' and when the lumber is dry the red light goes on and it is time to take the lumber out.

Shorter schedules are another benefit. Depending on what the mills are doing at the present time, we've had schedules anywhere from 10 to 40 per cent quicker. And there again, because of the extreme variance in the industry with regard to performance, in some cases 10 per cent or five per cent is all that we're gaining. In other places, it's as much as 40 per cent.

Better lumber quality is a definite gain. This is something that discourages us a little because when we put these controls in, a lot of people just want to look at how much quicker we get the lumber out. From my point of view, the real pay-back is that you get better lumber out of that kiln. If you are looking at three or four or five per cent less trim loss due to a better dry kiln, then that's really where the big pay-back is.

A shorter schedule, although it gets more production through your dry kiln, shouldn't be the complete measurement on whether the unit is a success. We would like to see more of our customers doing tests for lumber quality.

In some cases we have had very good gains on energy savings—from five to 25 per cent. Another plus when we get the control working is better grouping. We find that balsam is coming out still wet but it's closer. It is pretty hard to dry balsam in a mixture of spruce pine and try to take the spruce pine to 15 per cent and put that four or five per cent balsam in there and hope it is going to come out dry as well. Our experience has been that we still get wet balsam unless we overdry the other material.

In pretty well every case we are getting closer to dry than we were. We don't have any probes or sophisticated processes associated with this control. It is a reasonably easy unit to service from a standpoint of maintenance and you more or less change a card if the card fails. It is reasonably self-diagnostic and we don't find that people have too much trouble with it from a service point of view.

* * *

Management and Process Control Systems

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Today we have a productive capacity in North America to probably build over three million homes a year. Many experts predict one and a half million homes a year for the whole of North America over the next 10 years. If that is the case, only those mills that have a competitive edge stand any chance for survival in the years ahead.

Many speakers have covered the subject of acquiring this competitive edge by implementing the techniques of:

- Scant sawing
- Reducing saw kerf without losses in production rates
- Optimizing product mix for either highest recovery in terms of LRF highest dollar yield, or maximum contribution to profit

It is no longer possible today to buy a forest and liquidate it quickly into a profit. Therefore, sawmilling today is an art. There are three major requirements we have to fulfill in order to excel at the practice of this art:

- You must understand the underlying theory.
- You must practice the art in order to become a master of it.
- Most importantly, there must be a total commitment from management right down to the operating level in order to truly master the art that sawmilling has become.

Today the technology exists to scan incoming stems from the forest (Figure 1) very precisely to:

- Determine its geometry
- Utilize optimization techniques based on Best Opening Face sawing solution programs to optimally buck stems into short log segments entering the sawmill.
- Generate stem tally reports.

Those mills that have log sort capability can automatically sort logs to various bins, not only by log size classes, but preferably by set classes corresponding to log breakdown machines. The capability also exists to re-scan all of the logs that come into the mill using the same type of best opening face optimization techniques to automate the setworks positioning of the headrig log breakdown machines.

You have also heard about lumber profile scanners that define the wane geometry of boards for use in edging and trimming optimization systems and the automatic sorting of lumber. Actual log and lumber measurement data are fed into the mill's management information system for direct comparison with the theoretical lumber output which should have been produced from the log mix processed.

The measure of the mill's operating efficiency is the ratio of the actual LRF to the theoretical LRF. Yours is a perfect operation when that ratio is equal to one. However, the measure of your efficiency is determined by how close you approach one under different operating conditions. Even more importantly, management is provided a decision tool for correcting efficiency problems on a timely basis.

Figure 2 represents a typical example of merchandizing a tree length stem to its best end use. The standing tree, particuarly on the West Coast, cannot be hauled on most highways tree length to the mill, and invariably requires a woods bucking cut to reduce the tree to a butt stem and a top stem.

The woods bucking cut is one of the most important financial decisions and it is probably the most unscientifically made cut of all. Ideal merchandizing

successively until light is blocked by the physical presence of a log in the scanning field of view. The computer counts the number of blocked elements and determines the log's diameter to an accuracy of 0.1 inch.

This optical calipering technique between parallel light lines on 0.1 inch centers is so fast that a scan is taken approximately every 0.5 inches along the length of the log travelling at about 350 linear feet per minute. Scanning accuracy remain the same anywhere within the scanning field of view, even if there is log bounce within the vertical and horizontal planes.

NAC light calipering scanners mounted on two or more axes can be used to detect sweep and crook, provided logs are conveyed through the scanner without wobbling from side to side. One of the parallel light lines is considered a '0' Reference Line, from which the computer counts the number of elements to the outer and inner edges of the log, and by subtraction deduces the diameter and sweep as illustrated in Figure 7.

Light emitting diode technology was selected for the NAC scanner because of its recognized high reliability and long life in typical consumer products such as calculators, wrist watches, and so on, with a usable life of 10 or more years. Laser scanners, on the other hand, have a usable life of about 1.5 to 2.5 years.

The theory already exists to include sweep in the algorithms for optimized bucking and log breakdown but its implementation in sawmills will have to wait until engineers design conveyors that inhibit log movement as they are transported through the scanner. Box chain is not an ideal log conveying medium to minimize wobble.

The scanner's internal electronics, which although comprised of an abundance of components, still requires relatively little maintenance. A scanner system installed for the Weyerhaeuser Company in Cottage Grove, Oregon, since 1973 has required virtually no maintenance from NAC over the last 10 years.

Sorter memories are now developed to the point where they can truly be described as 'standard' products, requiring little or no field service support for installation.

Weldwood of Canada at Houston, B.C. has four log bucking lines provided with scanners and length measuring systems for tree length stems up to 85 feet. Adequate distance was provided in the original design for scanning the entire stem before computing the optimum bucking solution.

A single computer controls all four bucking lines and displays to each operator the optimum bucking sequence for implementation. After bucking, logs are automatically routed by size corresponding to one of three decks servicing three Chip-N-Saws.

Optical limit switches are used to measure gross stem length and they are used in conjunction with a shaft encoder which is directly coupled to the head shaft of the conveyor and is used to correct for log slippage and to refine length measurement to plus or minus one inch.

A dual bucking line was installed at the former Crown-Zellerbach sawmill in Elk Falls, B.C., a design concept which I believe was borrowed from the Weyerhaeuser small log mill in Cottage Grove, Oregon. In a relatively cramped area CZ was able to install an infeed conveyor feeding stem full length through a NAC scanner.

Stems are automatically routed to one of two conveyors feeding the cut-off saws by monitoring the trailing ends of the preceding stem to determine conveyor availability and loading stems in a rythmic see saw fashion with a minimum gap. One operator should be able to control both of these bucking lines, processing up to 2,500 stems per shift.

Figure 8 illustrates the information displayed to the bucking operator. Stem length is displayed to the nearest one inch and butt and top diameter to the nearest tenth of an inch. The computer only displays the optimum bucking solution, which will maximize the value of lumber products from the entire stem after testing all of the permutations and combinations for that stem length.

In this case, an 18 foot plus 16 foot plus 14 foot plus bucking solution with 22 inches of trim loss was generated as optimum for the 51 foot one inch stem, having a butt diameter of 13.9 inches and a top diameter of 7.1 inches.

Other than displaying log production rates and the status of the system's photocells, the remainder of the video display is not cluttered up with data that an operator cannot get to grips with at high production rates, but is available to display diagnostic messages in the event of a system malfunction.

NAC scanners can be mounted on a half taper Chip-N-Saw or a full taper Chip-N-Saw. Depending on rate of taper, there is a general rule which says that logs from four to nine inches have a higher LRF broken down under a half taper asymmetric sawing method, whereas logs 12 inches in diameter and up have a higher recovery factor under a full taper asymmetric breakdown method. Logs in the nine inch to 12 inch diameter class represent a transition zone in

of the tree illustrated in Figure 2 would be as follows in a multi-processing complex:

- Butt log to a band headrig carriage for maximum grade recovery.
- The middle section of the stem approximates a cylinder and would be merchandized to a plywood plant.
- The smaller, more rapidly tapered top log would be bucked for breakdown into random length dimension lumber at a canter/twin or quad headrig Chip-N-Saw. The very small top logs would be merchandized into studs, possibly at a quad band.
- The residual top end would, of course, be converted into chips.

That is the best generalized concept of merchandizing a tree length stem to its best end use.

The basis of all this is the optimization technique known as best opening face (BOF). BOF is the acronym used to define what combination of products will return the highest value from each individual log to be processed.

Figure 3 depicts an optimum BOF solution on a log 20.4 inches at the small end, 16 feet long and tapering at the rate of two inches in 16 feet. The theoretical BOF solution calls for a 12-inch cant, a one-inch sideboard, and a two-inch sideboard on the left side of the cant and two two-inch sideboards, and a one-inch sideboard on the right side of the cant, indicating an asymmetric solution, requiring a headrig capable of offsetting the geometric centerline of the log from the centerline of the machine.

Let us assume that you want to build a new sawmill and you are planning to spend maybe $30-35 million. You hire consulting engineers, study the feasibility of the project in detail, and determine that the profitability looks good based on theoretical programs like BOF. You build the mill and then you turn over machine control to a third grade operator who is expected to implement this theory that has provided the justification for the investment.

The problem facing an operator is illustrated in Figure 4 on a log measuring 13.4 inches at the small end, tapering at the rate of two inches in 16 feet for eight feet to 20 feet in two inch increments. The first problem that confronts the operator is what cant size to select for that particular log. Even if the operator is given credit for being able to eyeball the diameter, the rate of taper, and the length of that log all to within accuracies of 0.1 inches, he cannot be credited with determining that a four inch center cant will generate a value of $47.45; or that an eight inch cant would yield a value of $44.78; a 10 inch cant $43.04; and a 12 inch cant $51.01. The spread between the worst decision and the best decision is about $8.

High production mills today, particularly here in Canada, can process up to 10,000 short logs every eight hours. Can a misjudgement costing up to $8 on one log be afforded?

As Figure 4 illustrates, the next log has a 13.6 inch small end diameter, or an increase of only 0.2 inches over the preceding log. It is doubtful whether an operator can eyeball that small a change in diameter at today's production rates. The optimum solution for a 13.6 inch log has increased the value of products to $53.87, or an additional $4.

The chances are, particularly with chipping headrig machines, that the succeeding log 13.6 inches in diameter would have the identical set as the preceding 13.4 inch log, and another $4 potential increase in yield would disappear in the form of chips at source. That is the problem facing the headrig operator.

Consider the problem facing the bucking operator. Incidentally, these are real numbers out of a U.S. mill. Figure 5 illustrates alternative bucking sequences on a stem 44 feet two inches in length, with a butt diameter of 11.5 inches and a top diameter of six inches. The computer selected an optimum bucking sequence for that stem of 16 feet plus 16 feet plus 10 feet, yielding a value of $31.25.

To derive this optimum solution, the computer examined about 156 different ways in which to buck that stem. If the operator had taken a first cut of 20 feet (as is fairly standard practice in the south with straight stems) he would have been forced to take a 20 foot top cut, leaving a four foot loss to chips and a total stem value of $27.45, or an approximate loss in dollar yield of $4.

The physical requirements of a typical lineal bucking system should provide the ability for scanning the entire length of stem before making any bucking decisions (Figure 6). Even today, most consulting engineers design bucking lines with the log deck about three or four feet from the cut-off saw, and then request a bid for a bucking optimization system after the facility is embeded in concrete.

The heart of any system is, of course, the scanner which must define precisely the geometry of the stem or bucked log. The NAC scanner comprises light emitting diodes (LED's) and corresponding photo diodes, both on 0.1 inch centers. Each LED is turned on individually for 50 ns and if its IR (infra-red) light is seen by its corresponding photo-diode, or eye, it is turned off and the next LED is turned on, and so on

which half taper and full taper intersperse inexplicably.

Figure 9 illustrates the kind of video display presented to an operator in a multiple headrig mill. Each operator sees the production level of his colleagues, and experience has shown that this inter-operator challenge has the effect of increasing productive capacity by up to 15 per cent.

Another scanning technique involves a transverse scanner to scan individual stems travelling lateral up to a lugged inclined Jackladder (Figure 10).

One scanner comprises transmitter and receiver elements mounted on one foot or two foot centers along a scaffold spanning the entire conveying assembly. A vernier transmitter/receiver section refines stem length measurement to within three inches.

Another system is capable of processing tree length stems at up to 12 stems per minute. This is probably the only system which has been installed in a log merchandizer as a truly dual redundant system. Every component has a backup which monitors the primary device and in the event of a data disparity, the system will alarm the operator by audible alarms and printed reports, and the back system unit takes on the operation until repairs can be effected.

There is no manual mode function in this system which is designed to merchandize tree length stems optimally for best end use to the sawmill, plywood plant, and residual tops to chips.

The NAC transverse scanner is also used in carriage scanning applications when log geometry and taper rate are previously calculated to facilitate independent knee positioning to the BOF.

NAC's dual process electronics cabinet generally has one processor and I/O rack dedicated to machine setworks control, and the other processor/IO rack acts as a supervisor running BOF programs offline and serving as an active spares package. The CPU/IO racks are mounted on a swing-out door providing easy access to them and to the power supply back panel. This design permits location of the cabinet against a wall, thereby conserving space in the computer room. To guard against infancy failures of electronic components, complete systems are tested for several weeks in a temperature controllable chamber where the temperature is oscilated from -40°C to 40°C.

Examples of management reports available from scanning and control systems are shown in Figures 11 to 14.

Finally, the management report of primary interest to mill management for monitoring operating efficiency against annual goals is shown in Figure 15. Shift data on stem input, bucked sawlogs into the mill, and projected lumber output is extrapolated over one year's operating shifts.

The difference between projected log cost and lumber sales realization represents the operating margin. At the end of each shift management can readily see if performance on that day, repeated over a one year operating schedule, would meet targeted profit goals.

Figure 16 illustrates the economic significance of high precision positioning setworks systems which is a first requirement in being able to reduce rough green target sizes.

In a typical mill processing 41,000 linear feet per shift through a C-N-S, the ability to reduce target size by 0.080 inches from 1.780 inches to 1.700 inches would realize $949.00 additional sales realization per year. Superimposing an optimized log bucking system in this mill would increase the operating margin by an additional $900,000.

At this point, I can only exhort all of you who are managers and operators to practice the art of sawmilling with all the technology available in order to master it and survive in the hard times ahead of us all.

* * *

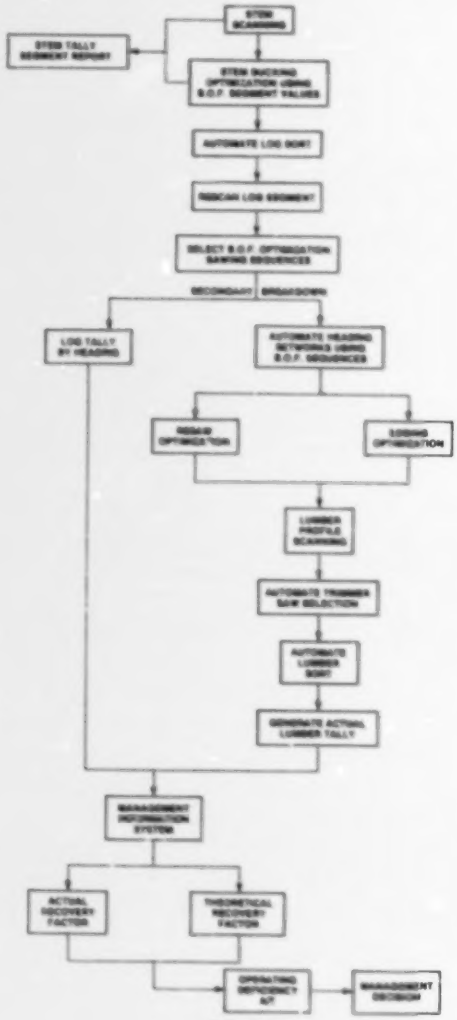

FIGURE 1

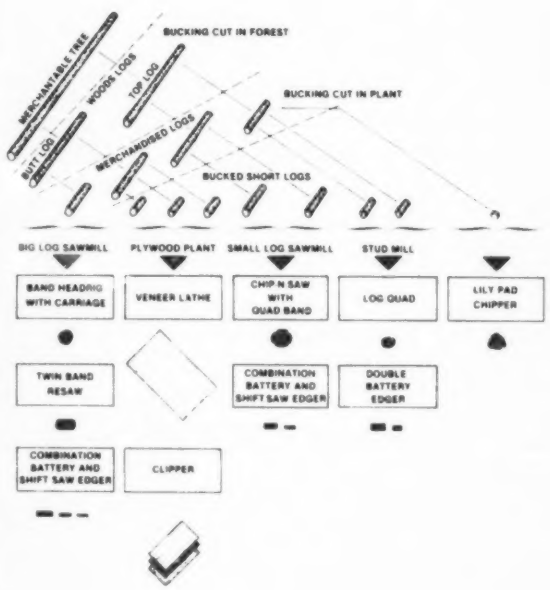

FIGURE 2

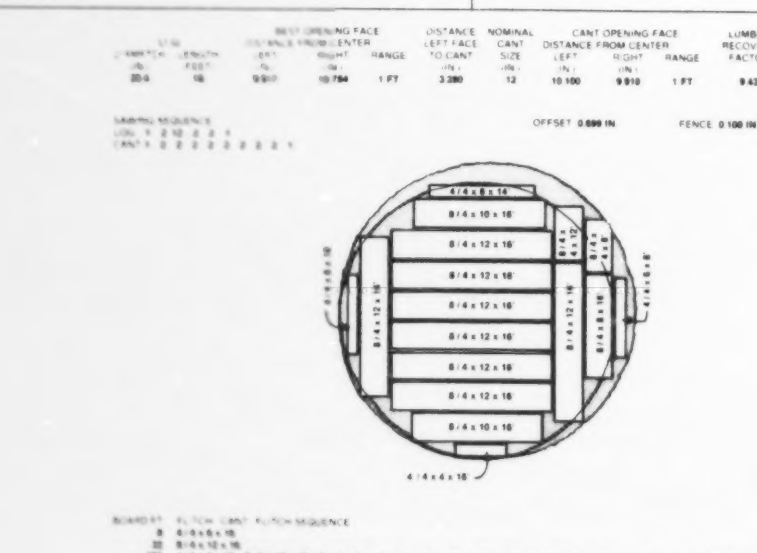

FIGURE 3

Figure 4

BOF Summary

Taper - 2 inches per 16 feet

12.4 in.	8 ft.	10 ft.	12 ft.	14 ft.	16 ft	18 ft.	20 ft.
Log Seq	2(2)- 4-2(2)-1	2(2)- 4-3(2)	2(2)- 4-3(2)	2(2)- 4-3(2)	2(2)- 4-3(2)	2(2)- 4-3(2)	2(2)- 4-3(2)
Cont Seq	7(2)	7(2)	7(2)	7(2)	7(2)	7(2)+1	7(2)+1
BF LRF	92 10.90	113 10.57	137 10.48	162 10.37	186 10.23	212 10.17	239 10.16
BED OFF	0.30 0.70	0.30 0.80	0.30 0.70	0.30 0.70	0.30 0.70	0.30 0.70	0.30 0.70
$Value	$ 19.09	$ 25.78	$ 34.04	$ 39.08	$ 47.45	$ 51.84	$ 61.62
Log Seq	1-1(2)- 4-2(2)	1-1(2)- 4-2(2)	2(2)- 6-2(2)	2(2)- 6-2(2)	2(2)- 6-2(2)	2(2)- 6-2(2)	2(2)- 6-2(2)
Cont Seq	7(2)	7(2)	7(2)	7(2)	7(2)	7(2)+1	7(2)+1
BF LRF	89 10.62	113 10.51	138 10.50	163 10.39	187 10.32	211 10.09	241 10.19
BED OFF	0.20 0.30	0.40 0.20	0.40 0.00	0.40 0.00	0.40 0.00	0.40 0.20	0.40 0.00
$Value	$ 19.83	$ 25.05	$ 35.16	$ 40.68	$ 48.76	$ 51.31	$ 64.42
Log Seq	2- 8-2	2- 8-2	2- 8-2	1(2)- 8-2(2)	1(2)- 8-2(2)	1(2)- 8-2(2)	1(2)- 8-2(2)
Cont Seq	7(2)	7(2)	7(2)	7(2)	7(2)	7(2)+1	7(2)+1
BF LRF	88 10.42	111 10.39	134 10.20	159 10.14	182 10.01	211 10.14	235 9.99
BED OFF	0.20 0.00	0.40 0.00	0.40 0.00	0.40 0.90	0.40 0.80	0.40 0.80	0.40 0.80
$Value	$ 20.03	$ 25.55	$ 35.32	$ 38.10	$ 44.78	$ 49.53	$ 62.16
Log Seq	-10-2	-10-2	-10-2	2-10-21	2-10-2	2-10-2	2-10-2
Cont Seq	7(2)	7(2)	7(2)	7(2)	7(2)	7(2)+1	7(2)
BF LRF	85 10.15	108 10.05	130 9.89	156 9.99	181 9.92	211 10.09	228 9.67
BED OFF	0.20 0.90	0.40 0.90	0.40 0.90	0.40 0.10	0.40 0.20	0.40 0.20	0.80 0.50
$Value	$ 18.02	$ 23.04	$ 32.46	$37.25	$43.04	$ 47.49	$ 59.46
Log Seq	-12-	-12-	-12-	-12-1	-12-1	1-12-1	1-12-1
Cont Seq	7(2)	7(2)	7(2)	7(2)	7(2)	7(2)	7(2)
BF LRF	88 10.42	111 10.39	134 10.20	159 10.22	183 10.10	201 9.68	228 9.67
BED OFF	0.20 0.10	0.40 0.10	0.40 0.10	0.40 0.20	0.40 0.30	0.30 0.00	1.30 0.00
$Value	$ 20.68	$ 29.16	$ 38.08	$ 41.34	$ 51.01	$ 59.43	$ 70.90
13.6 in.	8 ft.	10 ft.	12 ft.	14 ft.	16 ft	18 ft.	20 ft.
Log Seq	2(2)- 4-2(2)-1	2(2)- 4-3(2)	2(2)- 4-3(2)	2(2)- 4-3(2)	1-2(2)- 4-3(2)	1-2(2)- 4-2(2)-1	1-2(2)- 4-3(2)
Cont Seq	7(2)	7(2)	7(2)	7(2)+1	7(2)+1	7(2)+1	8(2)
BF LRF	92 10.59	114 10.49	140 10.36	164 10.21	189 10.08	219 10.20	243 10.04
BED OFF	0.40 0.40	0.40 0.90	0.40 0.80	0.40 0.90	0.20 0.40	0.20 0.10	0.20 0.10
$Value	$ 19.41	$ 26.62	$ 34.88	$ 39.99	$ 48.71	$ 53.35	$ 64.61
Log Seq	2(2)- 6-2(2)	2(2)- 6-2(2)	2(2)- 6-2(2)	2(2)- 6-2(2)	2(2)- 6-2(2)	2(2)- 6-2(2)	2(2)- 6-2(2)
Cont Seq	7(2)	7(2)	7(2)	7(2)+1	7(2)+1	7(2)+1	7(2)+1
BF LRF	93 10.78	117 10.52	142 10.53	167 10.36	196 10.49	209 9.79	248 10.21
BED OFF	0.40 0.00	0.40 0.10	0.40 0.10	0.40 0.10	0.40 0.10	0.40 0.40	0.40 0.20
$Value	$ 20.08	$ 26.28	$ 36.44	$ 41.89	$ 50.02	$ 52.31	$ 66.52
Log Seq	2- 9-2	1(2)- 8-1(2)-1	1(2)- 8-2(2)	1(2)- 8-2(2)	1(2)- 8-2(2)	1(2)- 8-2(2)	1(2)- 8-2(2)
Cont Seq	7(2)	7(2)	7(2)	7(2)+1	7(2)+1	7(2)+1	7(2)+1
BF LRF	91 10.40	116 10.49	140 10.36	165 10.23	192 10.28	218 10.19	224 10.04
BED OFF	0.40 0.10	0.40 0.20	0.40 0.90	0.40 0.80	0.40 0.90	0.40 0.80	0.40 9.90
$Value	$ 20.87	$ 25.99	$ 36.30	$ 39.84	$ 46.49	$ 50.67	$ 64.71
Log Seq	-10-2	-10-2	-10-2	2-10-2	2-10-2	2-10-2	2-10-2
Cont Seq	7(2)	7(2)	7(2)	7(2)+1	7(2)+1	7(2)	7(2)+1
BF LRF	88 10.13	110 9.95	136 10.06	162 10.09	188 10.06	214 9.99	240 9.91
BED OFF	0.40 0.80	0.40 0.80	0.90 0.80	0.40 0.20	0.40 0.10	0.80 0.00	0.80 0.10
$Value	$ 18.84	$ 13.48	$ 33.48	$ 39.00	$ 44.67	$ 49.24	$ 61.75
Log Seq	-12-	-12-	-12-	-12-	1-12-1	1-12-1	1-12-1
Cont Seq	7(2)	6(2)+1	6(2)+1	7(2)	7(2)+1	7(2)	7(2)
BF LRF	91 10.40	111 9.98	133 9.84	159 9.87	188 10.04	213 9.98	235 9.73
BED OFF	0.40 0.20	1.30 0.00	1.30 0.00	1.20 0.00	1.20 0.00	1.20 0.00	1.20 0.00
$Value	$ 21.52	$ 29.26	$ 39.21	$ 42.41	$ 53.87	$ 62.15	$ 74.03

Figure 5

Comparison of Bucking Sequences

	Lead		Trail		Length		Taper		Correl		Av Dev		Cubic		Brd Ft		LRF		Value		Solution	
	11.5		6.0		44' 2"		0.303		0.74		0.34		18.32		128		7.00		31.25		16 16 10	
M	13.4	13.0	12.1	11.6	11.5	11.2	11.1	11.1	11.0	11.0	11.0	10.9	10.8	10.8	10.7	10.5	10.3	10.3	10.2	10.2		
S	14.5	15.0	13.6	12.6	12.9	12.3	11.3	11.0	11.1	11.3	11.4	11.7	11.9	12.0	12.0	12.2	12.1	12.2	13.0	12.3		
M	10.2	10.1	10.0	10.0	10.0	9.9	9.9	9.7	9.6	9.5	9.5	9.1	9.0	8.8	8.6	8.6	8.6	8.5	8.4	8.4		
S	12.2	11.1	11.4	10.6	10.7	10.5	10.6	11.2	11.0	11.3	11.1	10.1	10.0	9.8	9.5	9.5	9.3	9.2	9.1	9.0		
M	8.3	8.2	8.1	8.1	8.1	8.0	7.9	7.9	7.8	7.7	7.7	7.7	7.7	7.7	7.6	7.6	7.5	7.4	7.4	7.4		
S	9.3	8.6	8.7	8.6	8.6	9.0	8.5	8.6	9.0	9.4	8.5	8.2	8.3	8.4	8.4	8.9	9.5	8.1	8.1	8.1		
M	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.1	7.1	6.9	6.9	6.9	6.9	6.8	6.8	6.8	6.8	6.7	6.6	6.3		
S	8.6	8.1	8.1	7.9	7.6	7.9	8.1	7.7	7.7	7.5	7.6	7.6	8.1	8.2	7.3	7.7	7.7	8.2	7.0	6.8		
M	6.2	6.1	6.1	6.0	6.0	6.0	5.9	5.8														
S	6.9	7.4	6.8	6.4	6.5	6.5	6.5															
	1 1x4x12		4 2x4x10			2 2x4x16		1 2x6x12			4 2x6x16											

Lead	Trail	Length	Taper	Correl	Av Dev	Cubic	Brd Ft	LRF	Value	Solution
11.5	6.0	44' 2"	0.303	0.74	0.34	18.32	119	6.51	27.45	20 20 *
1 1x4x12	1 1x4x18	2 2x4x10	3 2x4x20	1 2x6x16	2 2x6x20					
11.5	6.0	44' 2"	0.303	0.74	0.34	18.32	127	6.91	29.81	20 14 8 *
1 1x4x12	2 2x4x 8	2 2x4x10	1 2x4x12	1 2x4x14	1 2x4x20	1 2x6x12	1 2x6x16			
2 2x6x20										
11.5	6.0	44' 2"	0.303	0.74	0.34	18.32	128	6.99	30.20	20 12 10*
1 1x4x12	4 2x4x10	2 2x4x12	1 2x4x20	1 2x6x12	1 2x6x16	2 2x6x20				
MIR										
11.5	6.0	44' 2"	0.303	0.74	0.34	18.32	126	6.86	28.31	18 16 8 *
1 1x4x12	2 2x4x 8	2 2x4x10	1 2x4x14	1 2x4x16	1 2x4x18	1 2x6x14	1 2x6x16			
11.5	6.0	44' 2"	0.303	0.74	0.34	18.32	127	6.95	28.31	18 16 8 *
1 1x4x12	4 2x4x10	2 2x4x14	1 21x4x18	1 2x6x16	1 2x6x18	2 2x6x18				
11.5	6.0	44' 2"	0.303	0.74	0.34	18.32	128	6.99	29.33	18 12 12*
1 1x4x 8	1 1x4x12	2 2x4x10	4 2x4x12	1 2x4x18	1 2x6x12	1 2x6x16	2 2x6x16			
MIR										
11.5	6.0	44' 2"	0.303	0.74	0.34	18.32	127	6.92	30.63	16 18 8 *
1 1x4x12	2 2x4x 8	2 2x4x10	1 2x4x16	1 2x4x18	1 2x6x12	4 2x6x16.				

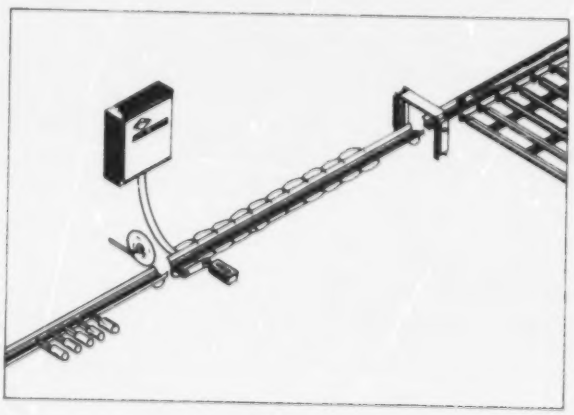

FIGURE 6

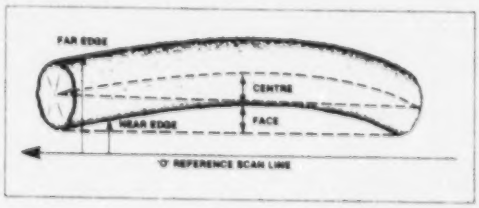

FIGURE 7

Figure 8

Bucking Operating Video Display

Stems	333	299	305*	327
Blocks	894	812	849	886
Stop	**********	* ***		
Scan 12.5	Speed 2.2			
Clear Infeed At Lunchtime				
Diameter	Length	Fit		
13.9	7.1	51'	1"	Good
Trim	22 SOL	18	16	14

Figure 9

03:24 p.m.

Logs				
CNS 1	2268	Cant	Pcs	Bed
CNS 2*	2009	6	4	6
Jumbo	1762			
Mk:		Dia:		0.0
Small	**Large**	**Length**		**T / C**
4.3	5.3	16' 5"		1
9.5	12.5	17' 3"		3
8.1	9.8	20'5"		2

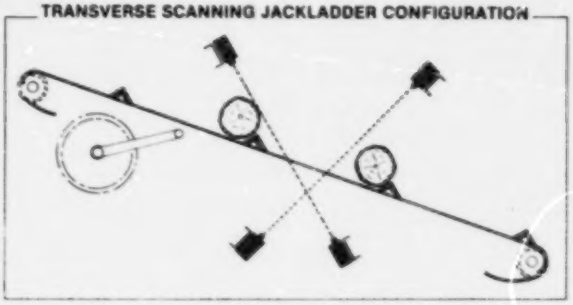

FIGURE 10

Figure 11

Stem Tally Report of Pieces and Cubic Volume
by Length Classes With a Graphical Histogram to
Readily Identify Major Trends

Log Bucking
Log Tallies

07/01/83 13:24:07

Last Cleared: 07/01/83 11:37:17
Steam Tally by Length Classes

	Pieces	% by Pcs	Cubic Ft	% by CFT	
Short	13	1.3	169	0.9	X
22'	16	1.6	155	0.8	X
24'	18	1.8	208	1.1	X
26'	25	2.5	1.4		X
28'	65	6.4	745	4.0	XXXX
30'	60	5.9	739	4.0	XXXX
32'	63	6.2	869	4.7	XXXXX
34'	69	6.8	1049	5.7	XXXXXX
36'	85	8.4	1311	7.1	XXXXXXX
38'	67	6.6	1071	5.8	XXXXXX
40'	62	6.1	1099	6.0	XXXXXX
42'	91	8.9	1660	9.0	XXXXXXXXX
44'	72	7.1	1332	7.2	XXXXXXX
46'	92	9.0	1970	10.7	XXXXXXXXXXX
48'	55	5.4	1198	6.5	XXXXXXX
50'	56	5.5	1379	7.5	XXXXXXXX
52'	29	2.9	780	4.2	XXXX
54'	21	2.1	603	3.3	XXX
56'	26	2.6	790	4.3	XXXX
58'	13	1.3	415	2.3	XX
60'	13	1.3	419	2.3	XX
62'	6	0.6	197	1.1	X
Total	1017		18411		

Figure 12

Stem Tally Report by DBH Classes - Useful Data for Confirmation of Forest Inventory Surveys

Stem Tally by DBH Classes

	Pieces	% by Pcs	Cubic Ft	% by CFT	
6"	5	0.5	29	0.2	
7"	32	3.1	233	1.3	X
8"	126	12.4	1275	6.9	XXXXXXX
9"	212	20.8	2745	14.9	XXXXXXXXXXXXXXX
10"	231	22.7	3851	20.9	XXXXXXXXXXXXXXXXXXXX
11"	183	18.0	3667	19.9	XXXXXXXXXXXXXXXXXXX
12"	107	10.5	2636	14.3	XXXXXXXXXXXXX
13"	71	7.0	2098	11.4	XXXXXXXXXXX
14"	29	2.9	1017	5.5	XXXXXX
15"	13	1.3	530	2.9	XXX
16"	5	0.5	221	1.2	X
17"	1	0.1	48	0.3	
18"	2	0.2	60	0.3	
Total	1017		18411		

Figure 13

Sawlog Tally by Length Classes

	Pieces	% by Pcs	Cubic Ft	-% by CFT	
8'	75	2.9	136	0.7	X
10'	74	2.8	188	1.0	X
12'	679	25.9	4088	22.5	XXXXXXXXXXXXXXXXXXXXXXX
14'	273	10.4	1507	8.3	XXXXXXXX
16'	708	27.0	4573	25.1	XXXXXXXXXXXXXXXXXXXXXXXX
18'	158	6.0	939	5.2	XXXXX
20'	652	24.9	6765	37.2	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Total	2619		18196		

Figure 14

Downtime Report by Reason, Generated on a Pushbutton Panel by the Operation

System Usage Analysis

	Percent of Total	
System Usage	76.7	4 hr 30 min
System Idle:		
Reason Unspecified	23.3	1 hr 22 min
Debarker Down	0.0	0 min
Electrical	0.0	0 min
Mechanical	0.0	0 min
Transfer Deck is Full	0.0	0 min

Figure 15

Management Report

	Units	Per Shift	Per Year	Value
Stem Input				
Avg. Stem Length	ft.	47.9'		
Avg DBH	in.	9.6"		
Stems Process	Nos.	1324	522,600	
Stem Volume - $58.50/cord	cords	318	127,688	
Stem Volume - $80/Cu.Ft.	Cu.Ft.	23,293	9,317,188	$7,469,760
Trim Volume	Cu.Ft.	638	255,200	
% Trim Loss	%	2.7%		
Bucked Logs to Mill				
Avg. Small End Diameter	in.	7.0"		
Avg. Bucked Log Length	ft.	18.1'		
No. of Logs 8' - 20'	Nos.	3818	1,527,200	
Lineal Feet Process	Lin.Ft.	81,404		
Avg. Log Processing Rate	Ft./Min.	115		
Log Volume - Doyle	B.F.	49,437	19,774,800	
Lob Cubic Volume	Cu.Ft.	22,655	9,062,000	
Lumber Output				
No. of Pieces Produced	Pcs.	13,020		
Pieces Processed per Minute	Pcs/Min.	24.5		
Product Mix:				
1x4 - 2.2% - $150/MBF	B.F.	3,404	1,361,600	222,744
2x4 - 40.4% - $259/MBF	B.F.	63,072	25,228,800	6,054,912
2x6 - 57.4% - $265/MBF	B.F.	89,779	35,911,600	9,696,132
Green Lumber Output	B.F.	158,255	62,502,000	$16,258,860
Falldown Adjustment - 15%		23,438	9,375,200	$2,438,803
Dry Finished Lumber - $260/MBF		132,817	53,126,800	$13,520,057
Operating Margin				
Lumber Recovery Factor	B.C./Cu.Ft.	6.8		
Cords Per MBF		2.03		

Readjustment of the operation to satisfy target goals can thus be undertaken in a timely manner.

Figure 16

	Manual Bucking			Optimized Bucking		
	1.780"	1.750"	1.700"	1.750"	1.750"	1.700"
StemsShift	945	945	945	898	898	900
Sawlogs to C-N-S	2,600	2,600	2,600	2,754	2,736	2,714
Lin.Ft.	40,898	40,872	40,898	40,898	40,872	40,898
Stem Cu.Ft. per Year	11,554,000	11,554,000	11,554,000	10,980,512	10,975,181	11,000,051
Lost Cost per Year	$13,443,870	$13,443,870	$13,443,870	$12,737,394	$12,731,210	$12,760,059
B.F. Lumber/Year	807,680,700	82,104,750	84,180,460	81,318,943	82,306,834	85,388,886
Lumber Value/Year	$19,540,393	$20,044,289	$20,489,169	$19,921,565	$20,231,856	$20,904,181
Operating Margin	$6,386,423	$6,891,728	$7,335,199	$7,284,028	$8,610,189	$6,234,672
Variances Due to:						
Scant Lumber Sizes	-	$505,325	$948,798	-	$326,161	$950,544
Optimized Bucking	-	-	-	$897,605	$718,481	$899,473
-Optimizing Bucking	-	$505,325	$948,796	$897,605	$1,223,766	$1,848,249

Program Summary and Closing Remarks

Ray Clarke
Associate Director, Forintek Canada Corp., Vancouver, B.C.

I think we have heard the good news and the bad news. The bad news is we are facing a period of change with respect to the resource. We can expect lowering sizes and lowering quality. We can expect increasing costs for delivered work, and we can expect increased competition. The good news is that as Al Coombes and Bob Blanchard pointed out, we appear to be moving towards that commitment to efficiency that Ed Rickford referred to. We heard from Charles McCaffray that the community colleges are putting out more courses—more flexible courses—to meet this challenge of retraint, and that the federal and provincial governments are providing more funds for this purpose. Gene Smith indicated that some of those Industry, Trade and Commerce programs are going to be simpler to access and they are going to be regional which is going to make it easier for the industry to find out what can be done.

Overall, the impression that I get, not only at this meeting, but at meetings right across the country, is that the industry is coming out of this most punishing recession with an attitude which is positive and aggressive to approach this necessary change. On the technical side, my impression is that we are getting pretty sophisticated in this industry. The directions of change are becoming pretty well defined in terms of rapid improvements in programmable controllers and rapid developments in the area of scanners. We are moving forward from the optimized trimming and edging to automatic grading. More sophisticated positioning is bringing us into the area of robotics and we are going to deal with that subject at our next seminar in Vancouver.

Examples abound across the country where the recovery improvement opportunities mentioned above have been achieved using advanced technology. However, the industry's own assessment of the percentage of wood being processed with advanced equipment is only 10 per cent.

A major reason given by the industry for the apparent slow introduction of conversion efficient equipment is a lack of sufficient quantitative information on the relative costs and benefits to be gained from such equipment. Increased information is required to dispel the mystery associated with the use of computers. This information is required at all levels of management and labor. Of particular value during the seminars were examples of specific mill experiences which dealt with all aspects of the introduction of new technology from installation, operation, maintenance and training of personnel. Successful introduction of equipment has frequently taken years of patient effort from both management and labor. To speed up the adoption of computer assisted technology in our industry, information programs must play an important role.

Increasing wood costs, as we make the transition to second growth timber, must be offset by increased productivity. Labor, management and government must work together to achieve this goal if the challenges which have been highlighted in this seminar are to be met.

* * *

Forintek Canada Corp.

Canada's National Wood Products Research Institute

Established in 1979 as a private, non-profit corporation. Forintek is funded from contract research work, industry support, and government grants and contributions. The staff of 200 is about equally divided between its Western Laboratory in Vancouver and its Eastern Laboratory in Ottawa. The corporate office is located at Vancouver, at the Western Laboratory.

A key element in the operation of Forintek is industry involvement in its research programs. This is accomplished through Research Program Committees and a Board of Directors which consist largely of senior representatives from industry, as well as representatives from federal and provincial governments. It is through these forums that a means is established for industry to have strong input into Forintek's operation, program planning and assessment.

By responding to industry's research needs directly, Forintek plays a vital role in solving technical problems and helping the Canadian wood products industry maintain its competitive position in world markets.

"Productivity improvement" is a common objective for industry and government alike. Accordingly, the federal Department of Industry, Trade and Commerce and Regional Economic Expansion is financing a series of seminars addressing productivity improvement through electronic-based technology. Forintek Canada Corp. will be presenting these seminars on behalf of the federal government during 1983 and 1984.

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